

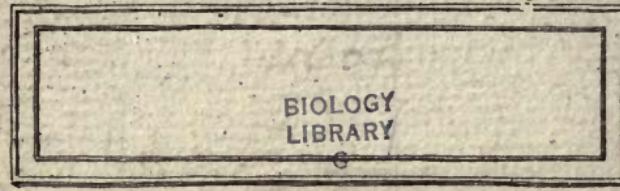
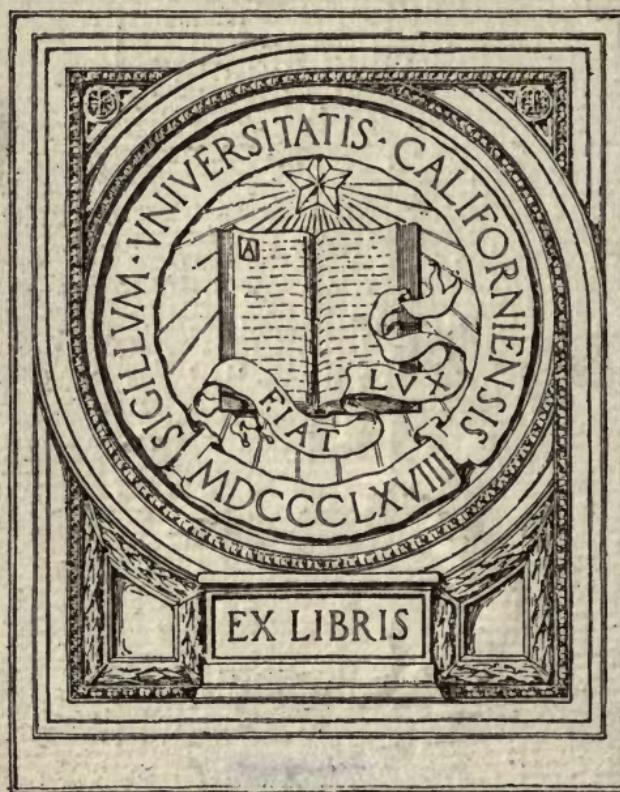
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# HEREDITY: A STUDY.

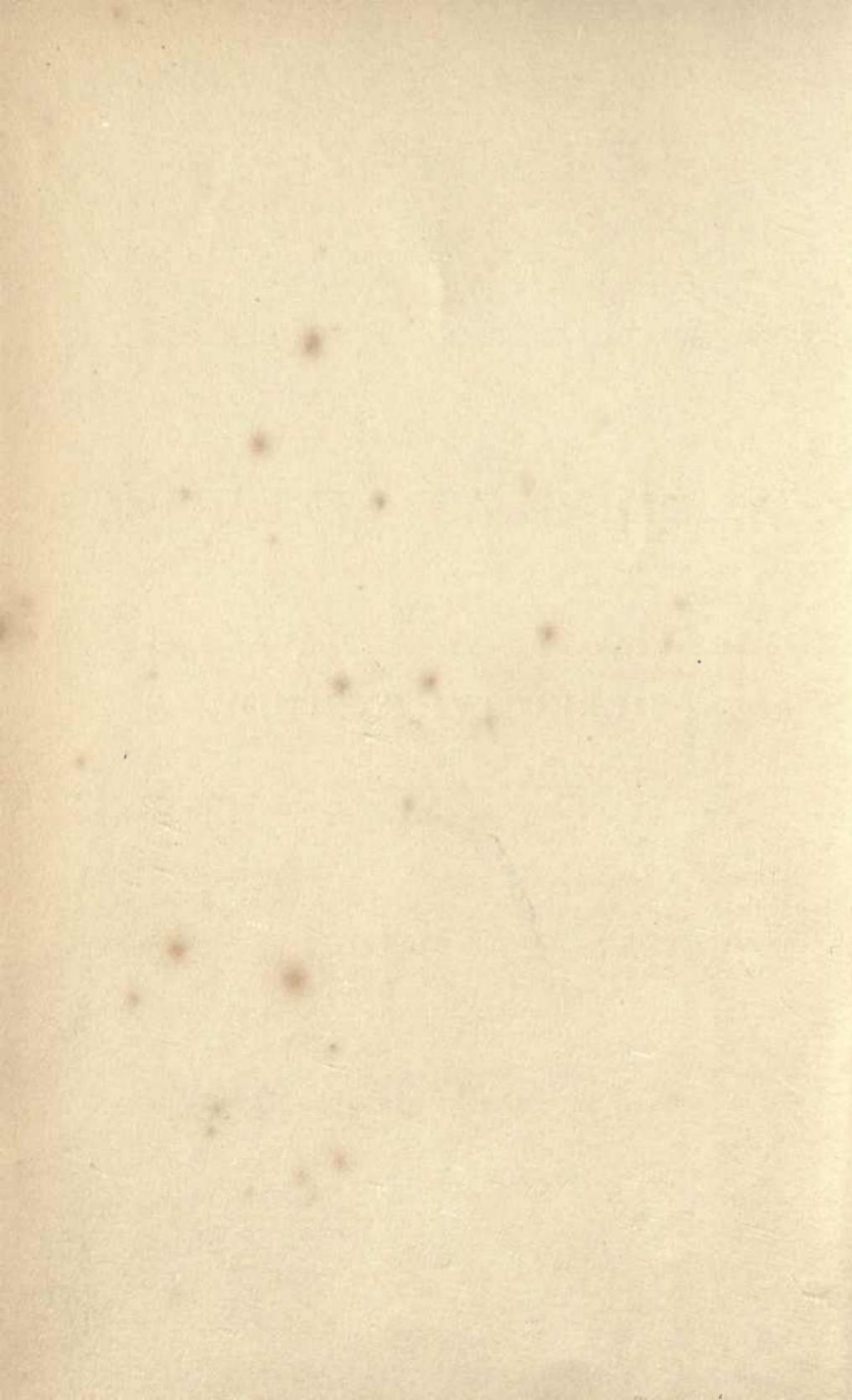
*R. A. DOUGLAS LITHGOW.*







HEREDITY: A STUDY.



# HEREDITY :

A STUDY ;

WITH SPECIAL REFERENCE TO DISEASE.

BY

R. A. DOUGLAS LITHGOW,

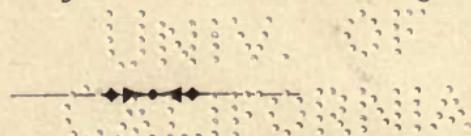
LL.D., F.S.A., F.R.S.L., F.R.G.S.I., M.R.C.P., L.R.C.S. ED.,  
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“I have been dealing with old names and well-established doctrines, and my reason for bringing them before you has been, not so much the hope of being able to contribute new facts or theories of my own, as the desire to set in better order that floating knowledge which is a general possession.”

*Mr. Jonathan Hutchinson's “Pedigree of Disease.”*



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TO  
JONATHAN HUTCHINSON, F.R.S., F.R.C.S.,  
ETC., ETC.,  
AN ACCOMPLISHED SURGEON,—AN ORIGINAL THINKER,—  
A GRACEFUL WRITER,  
WHO  
HAS DONE, PERHAPS, MORE THAN ANY OTHER LIVING AUTHORITY  
TO PROVE THE INFLUENCE OF HEREDITY IN PATHOLOGICAL  
PROCESSES,  
THIS LITTLE BOOK  
IS,  
(BY PERMISSION)  
MOST RESPECTFULLY AND ADMIRINGLY  
DEDICATED  
IN TOKEN OF  
MANY PERSONAL KINDNESSES.

357758



## P R E F A C E .

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THE contents of this little volume first appeared in the PROVINCIAL MEDICAL JOURNAL during the years 1887 and 1888, under the title of "From Generation to Generation : a Prelude to the Study of Heredity;" but inasmuch as I found that I had been anticipated in the first part of this heading, I have, for obvious reasons, altered it to the present title, although I still prefer the former as indicating better the character I claim for the work—viz., a mere outline of the subject.

For many years past I have taken much interest in the question of Heredity, and have thus accumulated an immense quantity of information concerning it. The following pages contain the merest outlines of the physiological and psychological aspects of the subject, although I take some credit to myself for making, what I believe to be, the first systematic effort to trace the influence of Heredity in all the main diseases which afflict humanity.

Wherever possible, I have chosen rather to quote from the greatest authorities, than to detail in my own words the many interesting facts referred to ; thus presenting a picture in which the lights and shadows have been added by the great Masters to the sketch of the Student.

If I am successful in evolving a deeper lay and professional interest than has hitherto been taken in a subject so intimately concerning the welfare of both classes, I shall be more than repaid for having made the effort.

27A, *Lowndes Street,*  
*Belgrave Square, S.W.,*  
*April, 1889.*



## FROM GENERATION TO GENERATION: A PRELUDE TO THE STUDY OF HEREDITY.

HEREDITY is one of the fundamental laws underlying the grand scheme of evolution; and without the former, the latter would lose all its significance and force, for by its action the development and perpetuation of species is maintained amid incessant variation, and all organised beings tend to repeat themselves in their descendants. As Ribot says: "Heredity and evolution are the two necessary factors of every stable modification in the domain of life. Suppose evolution without heredity, and every change becomes transitory, every modification whatever, whether of good or bad, useful or hurtful, disappears with the individual. . . . Suppose heredity without evolution, and there is nothing but the monotonous conservation of the same types, fixed once for all. Physiological characters and instincts, intellectual and moral faculties, are preserved and transmitted without modification. . . . On the other hand, suppose both evolution and heredity, and then life and variation become possible. Evolution produces physiological and psychological modifications, habit fixes these in the individual, heredity fixes them in the race." Considered ideally, heredity would be a simple question of like begetting its like, but this is not so, as vital phenomena are not characterised by such rigorous exactitude, the modifications of their existence tending to become more and more complex as we ascend from the vegetable to the animal world, up to man himself.

The phenomena of heredity, in a general sense at least, have been observed by all people at every age of the world's history. Thus in the ancient and sacred laws of Manu, we find the following aphorisms:—"A woman always brings into the world a son gifted with the same qualities as he who begat him." "We may know by his acts the man that belongs to a low class, or who is born of a disreputable mother." "A man of low birth has the evil disposition of his father, or of his mother, or of both—he can never hide his descent." So also in the Mosaic law:—"I, the Lord, thy God, am a jealous God, visiting the iniquities of the fathers upon the children to the third and fourth generation, etc." Elsewhere in the Bible we read:—"When the fathers have eaten sour grapes, the children's teeth are set on edge." The well-known lines of Horace are as follows:—

" Fortes creantur fortibus et bonis  
 Est in juvencis est in equis patrum  
 Virtus, nec imbellem feroce  
 Progenerant acquilœ columbam."

*Horace, Lib. iv., Ode 4.*

Lastly also, Goethe, in his *Iphigenia* :—

" How blest is he who his progenitors  
 With pride remembers, to the listener tells  
 The story of their greatness, of their deeds,  
 And, silently rejoicing, sees himself  
 The latest link of this illustrious chain !  
 For seldom does the selfsame stock produce  
 The monster and the demigod : a line  
 Of good or evil ushers in at last  
 The glory or the terror of the world."

The Lamarckian axiom that "Like produces like" can only be regarded as a generalization, which however true as such, yet when subjected to minute examination is found to be erroneous, inasmuch as the tendency of like to produce

like is not only modified by the influence of external circumstances, but to a still greater extent by that tendency to variation which is manifested in all animals, and which Darwin regarded as the greatest argument in favour of his theory of evolution. There are in fact no two beings precisely alike; brothers and sisters present many differences; and even were they formed according to the undisturbed force of hereditary transmission, endless diversifications would result from inevitable diversities of proportion of transmission, parental, as well as ancestral. The operation of hereditary tendencies is perpetually disturbed by innumerable circumstances too subtle for us to appreciate, and yet capable of producing varieties infinite alike in extent and degree. How these spontaneous differences occur we cannot tell; but that individual varieties are transmissible, and capable of producing new races in domesticated animals by artificial selection is indisputable; and in the human family the tendency to spontaneous variation is even still greater.

I now propose to view heredity in its physiological, psychological, and pathological aspects, and in the space at my disposal to give at least some general idea of this most important biological law.

There are few natural phenomena more interesting and marvellous than those affecting inherited peculiarities of feature, figure, character, constitution, habits, etc., and their perpetuation, and the numerous facts of hereditary transmission are all the more wonderful when we contrast them with other and better-known phenomena, which experience and scientific progress have enabled us to group under certain definite laws. The laws of planetary motion are recognised, and to a great extent understood; the systematic

order of chemical changes is appreciated with scientific precision, and the phenomena of heat, light, and electricity are gradually being unfolded and revealed. The phenomena of inheritance, however, although recognised to some extent, as I have said, from the earliest ages, have but recently been subjected to such analysis as enables us to refer them to a biological law; and, notwithstanding that this must be regarded as a later, and less perfect revelation, when compared with the other sets of phenomena to which I have alluded, yet the phenomena of inheritance are by degrees finding interpretation, and in all probability the grand law of heredity will ere long be as well recognised, and as firmly established as any of the so-called laws of the universe. "Natural laws," says Dr. Carpenter, "can only be regarded as the general expression of the conditions under which certain assemblages of phenomena occur, so far as those conditions are known to us;" or in the words of Mr. Lewis, "the paths along which forces travel to their particular results." If phenomena be reducible to a law, their investigation constitutes a science. Science can only deal with phenomena and experience; and when we come to regard the ultimate causes of any of these groups of natural phenomena, and find them not reducible to law, they must be attributed to the supernatural, as science pauses paralysed at the very threshold of such an inquiry. The conditions under which the phenomena of inheritance occur, in so far as they are known, enable us to group these phenomena so that their general expression represents a law; and in proportion as these groups can be accurately defined and interpreted, they are the effects of the biological law of heredity, just as the phenomena of gravity are of the great law of gravitation.

All natural laws are mysterious when an attempt is made to trace them to their real cause. "It is the office of science," says Bacon, "to shorten the long turnings and windings of experience." It is also the office of science to interpret the "how;" but the "why" is inscrutable and far beyond the powers of her revelation. As an anonymous writer has well said: "Gravity is a mystery of mysteries to the astronomer, and has almost compelled us to believe in that 'action at a distance' which Newton asserted to be unimaginable by anyone with a competent power of reasoning about things philosophical. The ultimate cause of chemical changes is as great a mystery now as it was when the four elements were believed in. And the nature of the ether itself, in which the undulations of heat, light, and electricity are transmitted, is utterly mysterious, even to those students of science who have been most successful in determining the laws according to which the undulations proceed. But the phenomena themselves, being at once referable (in our own time, at least) to law, have no longer the mysterious, and in a sense miraculous, character recognised in them before the laws of motion, of chemical affinity, of light, and heat, and electricity had been ascertained." It has been said that all our scientific knowledge, however coherent, however solid and fruitful in results, is like a gold chain of which we do not see the first link. Science regards each link in the chain of phenomena, records the facts, and interprets the power and purpose of each succeeding link. By analysis and synthesis, by induction and deduction, she groups the facts and phenomena into laws, and by the grouping of laws reveals the wonders of the universe; and thus, as Mivart says, "Our appreciation and comprehension of the world around us is but a continued repetition, on an

ever-widening scale, of successive processes of analysis and synthesis. In each branch of science, along with our keener and keener perception of differences, we come to perceive more and more recondite relations of agreement."

I have stated that heredity is a physiological law ; but it is a law within a law, being in a sense the effect of generation. The phenomena of inheritance have not only been observed, but the conditions realized ; and the analysis of these has indicated where we must seek for the laws of which heredity is the manifestation—laws which are subject to variation and individuation as other natural laws. Physiological heredity must be regarded as a physiological necessity of our being inseparably connected with the great law of reproduction, the process of which, although very imperfectly understood up to a comparatively recent period, has still more recently been brought much more within our comprehension, notwithstanding that our knowledge of its nature and functions is even yet incomplete. The respective characteristics and interdependence of reproduction and nutrition, long recognized, are now more fully manifested ; and nutrition has been correctly defined as "a perpetual reproduction."

This would be the place wherein to discuss the minute details of the reproductive process so far as they are known ; but as this would be beyond the scope of the present work, I can only refer the reader to the many and excellent text-books of physiology and embryology which the progress of science has rendered far in advance of their predecessors.

The generation of life from life is a mystery which science has not, and, perhaps, may never solve—a mystery in which many more mysteries are hidden—and amongst the latter

few more mysterious than those of hereditary transmission. Around, but outside, these arcana of nature, science is earnestly at work—seeking, recording—analysing, generalizing, and determined to force from even the heart of Nature her most hidden mysteries, if within the possibility of human achievement ; but until her eye is enabled to see far deeper than heretofore into that which is as yet inscrutable, the mighty problems of generation and transmission must remain unsolved, whilst those who follow in the train of science must, in the meantime, content themselves with general conclusions justified by phenomena, whilst they hopefully await the result.

Within two minute cells—one the “sperm-cell” of the male, the other the “germ-cell” of the female, and as such different in nowise from any other cells, so far as can be ascertained by any human power of analysis—and by whose fusion the “embryonic vesicle” is produced, lie hidden the mysteries of generation and heredity ; and science, with all her powers, can reduce them no further. Take these two little cells as representing a point equally dividing a right line, at each end of which is the barrier of infinity. From this point in one direction we follow man from the cell and its development, through uterine existence, and having within him the transmitted qualities of his parents and ancestry—physical, intellectual, and moral—acquiring individual modifications which will in turn be transmitted to his descendants,—through all the mazes of his life, for weal or woe, with all life’s power and purpose, until the destiny of his humanity is fulfilled, and he goes down into the “Valley of the Shadow,” having left his impress on his survivors, and into the presence of the Infinite ! From the same point in the

other direction, we may resolve the cells into molecules, and the molecules into atoms, and down, down, deeper, until, if possible, we reach the ultimate monad—the *μεγεθη αδιαιρετα*, amid the properties or endowments manifestly in the very nature of the ultimate fractional parts of matter, but the mystery of life is unsolved, and beyond life is Infinity.

In seeking for the physiological causes of heredity, it will thus be seen that they are bound up with the mysteries of generation, and in either case we have reached the ultimate revelation of science when we regard the fusion of two simple cells as resulting in the production of a compound cell—the “embryonic vesicle”—within which are enshrined the mysteries of reproduction and heredity.

All the elements and functions of the human body are subject to heredity—internal as well as external—its peculiarities, diseases, and even acquired modifications.

The likeness between parents and children is a matter of daily observation, not only as to form, feature, and expression, but also as regards the peculiarities of the limbs, trunk, head, nails, hair, skin, complexion, gait, voice, temperament, etc. That family likenesses will continue for ages may readily be seen from family portraits when they have been preserved for many generations; and, although seemingly lost in one generation, they will assuredly become manifest in a succeeding one. The phenomena of the external structure—those affecting the features and outward configuration of the body—although comparatively more common and of less engrossing interest, are not, nevertheless, the least instructive. The facts concerning the hereditary characteristics have, as has already been stated, been recognised from time immemorial by all peoples and

in every age ; hence the amazing peculiarity of the Jewish race, whose recognition of the force of heredity is shown by their having, at an early period, founded part of their judicial system in accordance with the observed transmission of physical, intellectual, and moral peculiarities from parents to children. The Greeks, also, were fully conversant with these phenomena, and the Spartans, regarding them as of still greater importance, actually made a selection from their newly-born children, thus endeavouring to secure only the “survival of the fittest !” The Romans, likewise, distinguished families by their hereditary peculiarities, denominating them on account of physical characteristics as *nasones*, or big-nosed ; *labeones*, or thick-lipped ; the *buccones*, or swollen-cheeked, and the *capitones*, or big-headed. The facts concerning the transmission of family likenesses, and of general characteristic resemblances which descend from ancestry and parents to children are so well and universally recognised that I need not now dwell upon them further ; they may be observed in every family, and wherever there are parents and children may be studied with much interest, not only as to the inheritance of family characteristics, but with special regard to the still more curious phenomena of individual peculiarities. It may here be observed that children, whose likeness to their mother is more apparent at one period of their lives, become much more like their father at another period. In accounting for this it has been stated that these phenomena depend upon the deep-lying potentialities of the family stock, which lie hidden and dormant in every individual until developed by either “the shock of the constitutional changes which take place naturally at particular epochs of life—the intimate bodily changes that are induced by the disturbing effects of such

abnormal events as fevers or other illnesses, or by the outer stimuli of particular circumstances of life.”<sup>1</sup>

The inheritance of the complexion and quality of the skin is so commonly observed that I need not do more than mention the fact; while, of all that concerns the shape and size of the body, I shall only refer to obesity or corpulence, which is without doubt very frequently hereditary, and the predisposition to it may be derived from either parent. Youth, middle, and old age are, perhaps, equally subject to this condition, but it occurs more frequently in females than in males, and in the single oftener than in the married. That nations are prone to it as well as families may be seen in the contrast between, for example, the Dutch and the Americans. As Ribot says:—“So truly is obesity the result of an organic predisposition, that it has often been known to make its appearance amid privations, and under all the disadvantages of hard labour and poverty.”

The internal, like the external, structure of the body is alike subject to the influence of heredity, and in the great work of Dr. Prosper Lucas may be found many striking examples. Thus, in the osseous, digestive, circulatory, muscular, and nervous systems,—in the fluids as well as in the solids of the body, the laws of heredity are as rigidly obeyed as in the external configuration. Ray, and Cuvier after him, went so far as to say that there is even a greater similarity in the internal than in the external structure of the body. Take, for example, the distribution of the external veins in the hands of two individuals, and they will be found to differ considerably: whereas, the internal veins in two different individuals will be found to closely correspond. The shape, size, and anomalies of the bones are also

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<sup>1</sup> Dr. Maudsley.

inherited, and their relative proportions preserved ; whilst in some families the heart and great blood-vessels are found naturally large, in others comparatively small. The relative size of the brain, and other peculiarities of the nervous system, are indisputably transmitted from parents to children ; and that certain families are characterised by a plethora or paucity of blood, or of bile, is a matter too well known to require further consideration.

What physicians denominate as idiosyncrasies are very frequently, if not invariably, inherited ; and that what have been termed the “subordinate” in contradistinction to the “dominant characteristics” are hereditarily transmissible is proved by the well-known facts as to fecundity and longevity which often characterise families for many generations. Just as some families are distinguished by the hereditary transmission of longevity, so may others be characterised by short duration of life, as strikingly exemplified in one generation after another. There are other cases of a still more interesting character where, from one generation to another, the members of certain families seldom, if ever, survive after a certain age. To this class of cases belong also the many instances of premature bodily and mental decay to which some families are subject as the result of heredity—the exemption, or comparative immunity shared by other families as to the influence of certain contagious diseases, and the increased susceptibility of others : and that muscular strength and special skill in certain physical exercises are hereditarily transmitted is a fact as well known now as in early times ; also lisping, stammering, shrillness and gruffness of the voice, nasal intonation, and loquacity.

That acquired modifications are also transmissible there can be no doubt ; and amongst these, perhaps, none more

certainly than peculiarities of habit—habit being understood to imply “an acquired disposition.” Curiously enough, experience seems to warrant the belief that the less important and remarkable the habit, the more likely is it to become hereditary and persistent; and of the many phenomena of heredity few are more curious and interesting than those which illustrate the transmissibility of individual peculiarities and eccentricities, however otherwise comparatively trivial in themselves, as frequently evidenced in many families. There are very numerous records of such cases, and, indeed, it is more than probable that close observation would enable us to detect evidence of such phenomena, varying of course in degree, much more frequently than is generally supposed.

The majority of people are undoubtedly right-handed, but some are naturally left-handed; and it is interesting, and sometimes amusing, to observe the many and various theories propounded to account for this curious physiological fact. One author goes so far as to suggest that left-handedness is a peculiarity akin to monstrosity, whilst another believes that those who are left-handed must be generally eccentric in every respect! I have no intention, however, of entering into any discussion regarding these speculations, and shall now only contend, as I am prepared to prove, that in a very large proportion of cases of left-handedness, there is a potential and indisputable element of heredity.

From the foregoing facts, to which many additions might be made, it will be seen that the grand law of heredity is intimately and inseparably associated with every anatomical conformation, and with every physiological function and process in the human, as, indeed, in the entire animal economy—not only general characteristics, but “the varieties, and the minutest peculiarities of the individual, in structure,

composition, and properties," being alike subject to hereditary transmission.

Congenital malformations, or native peculiarities in the human subject (and equally, indeed, in the lower animals), manifest the strong tendency to variability which exists in nature, and the infinity of means which she makes use of in order to accomplish the same ends. Slight deviations from the normal type are distinguished as *varieties*, while those of a more striking character are known as *lusus naturæ*, and those in which the deviation is so marked as to seem out of the course of nature altogether are regarded as *monstrosities*. These three degrees of deviation have been classified by Buffon as excesses, deficiencies, and misplacements ; and to these Blumenbach has added a fourth, *unnatural formations*. No hard and fast line of demarcation, can, however, be laid down, as the four divisions are frequently combined in one example, and each may in some degree co-exist with each—the grades and kinds of abnormal variations being simply infinite. Different varieties may not only occur in the same individual, but in different members of the same family ; and both excess and deficiency may co-exist in one subject, as in having too many fingers on one hand, and too few on the other. One part may be over-developed, whilst another in the same subject is deficient, as in cases where supernumerary fingers are associated with hare-lip or spina bifida ; and, in the same family, one member may have supernumerary fingers and toes, and another have a deficiency of one or both. Nothing, however, can be more certain than that these developmental freaks, whether of the nature of redundancy or deficiency, are transmissible, and frequently perpetuated through several generations, and therefore, as Ribot says, of great interest as shewing that "the individual

type is subject to the law of heredity no less than the specific type."

It must, however, be remembered that an exact likeness, either physical, mental, or moral, is never transmitted by inheritance ; neither an exact likeness of either parent, nor an exact composite of both. All breeders of stock know very well that if they wish to develop and perpetuate certain qualities in the offspring, they must exercise the greatest care in the selection of the parents ; and human beings, however well-informed, are far too prone to forget that similar laws are still more applicable to themselves. The fact is, that as the law of inheritance of like qualities in the lower animals manifests itself in simpler and less complex channels than in the human species ; so, also, it is less largely modified in the former than in the latter by laws of variation. As Dr. Maudsley says :—“ There is always a principle of variation at work in breeding, contesting the ground, as it were, with a principle of heredity, the effects of which are so great sometimes that resemblances are hidden or overborne entirely. Now, as the human body is the most complex organic substance in the world—‘ the most compounded mass in nature,’ as Bacon calls it—it affords infinite scope for modifications, neutralisations, and variations of qualities ; and the reasons are obvious why we cannot predict results. Countless variations may occur in each case. . . . Most of these variations die with the individual ; but some of them, meeting with fit surroundings, and being fostered thereby, are propagated from one generation to another, and become fixed qualities of the family stock. For the qualities of the stock are deeper and more stable than those of the individual, and the qualities of the species deeper and more stable than those of the family. The law of heredity is most evident in

the preservation of the character of the species, the law of variation in the determination of individual characters."

"According to the Darwinian theory," says Balfour, in his admirable *Comparative Embryology*, "there are two guiding—and, in a sense, antagonistic—principles which have rendered possible the present order of the organic world. These are known as the laws of heredity and variation. The first of these laws asserts that the characters of an organism, at all stages of its existence, are reproduced in its descendants at corresponding stages. The second of these laws asserts that offspring never exactly resemble their parents. By the common action of these two principles, continuation from a parent type becomes a possibility, since every acquired variation has a tendency to be inherited." The so-called theory of evolution is the sublimest philosophical conception of the present century, and has received its grandest expression in the elaborate works of Mr. Darwin, in which he has brought it to bear upon the highest problems which can engage the attention of mankind. Succeeding the metaphysical system of Hegel, it has itself been further extended by the more recent efforts of Mr. Herbert Spencer, Professors Huxley, Tyndall, and others; but with the name of Darwin will ever be associated the completion of the doctrine of the great organic revolution which may be said to have been originated by the illustrious Lamarck. As heredity is inseparable from evolution, I may here briefly glance at the salient points of the theory, as propounded by Darwin himself.

The theory of evolution as affecting biology asserts that "all the species of living beings, both animal and vegetable, have not been originally created as we see them, but are derived from ancestors of lower and simpler organisation

than themselves, by a process of descent with gradual modification ; that all species, however different they may be now, are descended from the same or perfectly similar ancestors, which, like the simplest living beings now known to exist, were minute gelatinous masses, without organisation or structure." In his work on "The Origin of Species," Darwin says that, in his belief, "animals are descended from at least only four or five progenitors, and plants from an equal or lesser number. Analogy would lead me one step further—namely, to the belief that all animals and plants have descended from some one prototype."

The theory has been thus fairly stated in outline :—"All organisms are more or less variable ; no two leaves in a forest are exactly alike, and the differences are often great enough to be quite conspicuous, as in the familiar case of human faces. At the same time these variations tend to become hereditary. Now, if any variation is such as to give its owner any advantage over other individuals of the same species, the owner of such a 'favourable variation' will be more likely than less favoured individuals to win a place in the struggle of existence, and to leave offspring. These offspring will tend to inherit the favourable variation that caused their parent to survive, and the same competition will go on among them. Those which possess the favourable variation in the highest degree will again survive, and the improvement will go on progressing and accumulating through generations. This preservation of favourable variation Darwin calls 'Natural Selection.'"

The influence of cultivation and domestication in the production of changes, and the difficulty in distinguishing between variations and species, are fully estimated and minutely considered by Darwin in the elaboration of his

theory. He draws an analogy between the artificial selection employed by breeders in the production and perpetuation of new breeds or varieties, and natural selection, or that process which all organised beings must undergo, whether animal or vegetable, in the "struggle for existence" against not only those other creatures which prey upon them, but to a still greater extent against those which are similarly nourished as themselves. "The struggle for existence inevitably follows from the high geometrical ratio of increase which is common to all organic beings." It is impossible that all should live. "A grain in the balance may determine which individual shall live, and which die—which variety or species shall increase in number, and which shall decrease, and finally become extinct." Thus it follows that, as only a fractional part of those which are born shall survive and produce descendants, the weaker, or those least fitted to conquer in the struggle for existence, must succumb and perish, whilst the stronger, more capable of overcoming by reason of their more favourable organisation, alone survive: and so the struggle for existence results in the "survival of the fittest."

Slight variations may be perpetuated, and those creatures which, owing to natural advantages, possess greater powers of attack and defence, and which are more adapted for the acquisition of nourishment, naturally overcome those less favoured, and eventually displace them. That striking modifications may be produced and perpetuated in the careful cultivation of plants is undeniably, and Darwin asks: "Can it, then, be thought improbable, seeing that variations useful to man have undoubtedly occurred, that other varieties useful in some way to each being in the great and complex battle of life should occur in the course of many

successive generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and procreating their kind?" In this way Darwin supposes "new variations to be continually taking place, but the greater number of them speedily to become extinct; whilst others, becoming perpetuated, and perhaps causing the extinction of the original forms, again give rise to other forms, until some of them have so widely diverged that all traces of their common origin is lost." "As buds give rise by growth to fresh buds, and these, if vigorous, branch out and overtop on all sides many a feebler branch; so by generation, I believe, it has been with the great Tree of Life, which fills with its dead and broken branches the crust of the earth, and covers the surface with its ever-branching and beautiful ramifications."

It would be foreign to the purpose of these papers to discuss at any length this grand theory of evolution. But, independently of all that might be said either in favour of or against it, it should always be remembered that of all possible theories of the origin of species, it is that which is most in harmony with the ordinary facts of experience. The origin of individual organisms is a matter of scientific observation; but the origin of species must still be regarded as inferential. Bearing in mind, however, that every living organism has been evolved out of a perfectly simple cell, in which the microscope shows no vestige of structure, it certainly seems more consistent with this fact that species have been developed by "descent with modification" from perfectly simple ancestral forms, than to believe that they have been created all at once just as we see them.

We must, therefore, regard heredity and evolution as inter-dependent and inseparable, as without heredity every change of modification of any kind could only exist transitively, and would inevitably cease with the individual ; and without evolution heredity could only necessitate the "monotonous conservation of the same types, fixed once for all." Life and variation are rendered possible by evolution and heredity, the former producing modifications which habit fixes in the individual, and heredity perpetuates in the race. As Ribot says : "These modifications, as they accumulate, and in course of time, become organic, make new modifications possible in the succession of generations. Thus heredity becomes in a manner a creative power."

Heredity in an individual consists of qualities both physical and psychical, which may be denominated ancestral, parental, and acquired. The latter qualities are without doubt transmissible, notwithstanding the fact that in many cases, especially when a race is left to itself, such deviation of type has, apparently, a tendency to revert to the normal state. Independently of some exceptional and reversal cases, it is a well-established fact—proved by the phenomena of physiological heredity, as detailed in innumerable instances of the transmissibility of acquired modifications—that by careful selection breeders are enabled not only to fix but to perpetuate certain physical characters. When those animals possessing such acquired modifications are "left to themselves," there is undoubtedly a tendency to revert to the primitive type ; but as the art of the breeder fixes them in the lower animals, so can they be perpetuated in man under certain definite conditions. "Thus there is established in the individual, between the

heredity of natural characters and that of acquired characters, a conflict, in which nature must win, if art does not counteract it.”<sup>1</sup>

Thus far we see that the study of heredity teaches us concerning the inheritance of like qualities—the dormancy or suspension of qualities which may become manifest on a particular occasion in the individual life or in subsequent generations (as evidenced by the fact that children whose likeness to their mothers is apparent at one period of their lives, at another will become much more like their fathers), and the combination to produce certain qualities or variations. I shall now briefly inquire into the so-called laws of heredity—empirical, no doubt, but applicable to the many oddities, exceptions, and contradictory opinions which complicate the question when we venture to proceed from theory to individual facts, and which may all be brought within the compass of the following few formulæries :—

I.—Direct Heredity.

II.—Reversional Heredity, or Atavism.

III.—Collateral, or Indirect Heredity.

IV.—The Heredity of Influence.

V.—Specialised or Initial Heredity.

De Quatrefages says : “ Clearly the mathematical law of heredity would be for the parent creature to reproduce itself in its progeny. And perhaps this law, absolute though it be, is to be found underlying all natural phenomena ; but in every case it is marked by accessory circumstances—by the conditions amid which heredity acts. But it does not only rest on theoretical considerations—it rests also on facts. Although subject to profound and continual disturbance,

<sup>1</sup> Ribot.

still, if we note all the phenomena which show in individuals a tendency to obey the mathematical law, heredity is found to realise in the aggregate of each species the result which it fails to realise in isolated individuals. To use a figurative expression, the true meaning of which cannot fail to be apprehended, while it cannot be verified in the whole, it may be in detail."

*Direct Heredity* consists in the transmission of paternal and maternal qualities to the children. This form presents two aspects—

I.—A child may resemble both its parents equally, as regards both physical and moral characters. This is comparatively rare, as it would be a manifest realisation of the ideal law.

II.—A child, whilst resembling both parents, may resemble one of them peculiarly. This second class admits of two sub-divisions—viz., (a) the likeness may be in the same sex—from father to son, from mother to daughter; (b) more frequently the heredity occurs between different sexes—from father to daughter, from mother to son.

(1) Perfect equilibrium is only compatible with "perfect equality of action—a perfect correspondence between the physical and mental constitution of the parents," which are not to be found; and thus, among the higher animals at any rate, the realisation of the ideal law is unattainable, owing to the absence of the necessary conditions. That there is always a preponderance of one of the parents is the one clear result arising out of the conflict of opinions. As Ribot says: "In the case of direct heredity the child is always more specially like either the father or the mother." The preponderance, moreover, is never exclusive, but always bi-lateral. "Although the influence of one of the parents

on the child may seem abolished, it is never annihilated," and thus "the law of equality of action is as far as possible realised." To sum up—a child, in the case of direct heredity, derives its qualities from both parents, but there is always a preponderance of one of them.

(2) The preponderance may be either direct or diagonal—viz., direct when the son resembles the father, and the daughter the mother; diagonal when the son resembles the mother, and the daughter the father. The law of diagonal heredity has comparatively few exceptions, and may be explained by a cycle of heredity, thus: by examining several generations, it is found to pass from the grandfather to the mother, and from the mother to the son; or from the grandmother to the father, and from the father to the daughter, then back again from whence it started. Cross or diagonal heredity is still more common when one of the parents presents any anomaly or deformity, thus: organic imperfections (as curved spine, lameness, rickets, sex-digitism, deaf-muteness, mycrophthalmy, etc.) pass from father to daughter, and from mother to son. Gall cites a case of twins of opposite sexes—the boy like the mother, very stupid; the girl like the father, very intelligent.

(3) The preponderance of one parent is sometimes shown in the children of the same sex, but instances of this kind are not so numerous as in cross heredity. Edward Lambert, "the Human Porcupine," transmitted his peculiarity only to the males of his family. Daltonism, or colour-blindness, is generally more frequent in men than in women, yet it has been transmitted through five generations, to twelve persons, all women! "Constitution, temperament, fecundity, longevity, idiosyncrasies, and anomalies of every kind, pass as often from father to son as from mother to daughter."<sup>1</sup>

*Reversional Heredity, or Atavism*, occurs when a child resembles its grandparents or earlier ancestors, and is a very influential law. The grandson very frequently resembles his grandfather, and the grand-daughter her grandmother. Lucas thus defines it : "Atavism is a term used to denote cases in which a child, instead of resembling his immediate parents, resembles one of his grandparents, or still remoter ancestor, or even some distant member of a collateral branch of the family—a circumstance which must be attributed to the descent of all its members from a common ancestor." It is also referred to by Aristotle, Galen, and Pliny. Montaigne says : "Is it not marvellous that this drop of seed from which we are produced should bear the impression not only of the bodily form, but even of the thoughts and inclinations of our fathers ? Where does this drop of water keep this infinite number of forms ? And how does it bear these likenesses through a process so hap-hazard and so irregular that the great-grandson shall resemble the great-grandfather, the nephew the uncle ?" Atavism has shown itself in the silk-worm after a hundred generations, and is beautifully exemplified in the vegetable kingdom, as shown by Dr. Broca. Reversional heredity is often manifested in insanity. Thus, an insane father may have clever and distinguished sons, probably geniuses, yet the offspring of these may manifest insanity at any time, even suddenly. Character, talents, aptitudes, and passions, afford many striking examples of atavism.

*Indirect Heredity* is in reality only a modification of atavism, differing from it only in appearance. It occurs when a child resembles in its physical, mental, and moral character, an uncle or aunt, or some other relative out of the direct line of descent. Some have denied that this

form exists, but that the influence of heredity manifests itself frequently under such circumstances is proved by innumerable facts as to resemblances of face, inclinations, passions, characters, deformity, and disease, between uncle and nephew, aunt and niece, grand-uncle and grand-nephew, and even amid the ramifications of distant cousinship. Ribot gives many instances in illustration of this law.

*The Heredity of Influence*, or pre-marital heredity, is seen when the child of a second or third marriage resembles the husband in a previous marriage. Although facts are forthcoming as to such an influence affecting "the lower and even the higher animals," yet so far as man is concerned, the instances of this are very few, if they occur at all. This form is, moreover, in an unnatural order, and presents no real analogy to either direct, reversal, or indirect heredity, as it would necessitate a child "resembling a person who has nothing in common with him, save that the person was once its mother's husband."

*Specialised, or Initial Heredity*.—This is a form of heredity of considerable importance, although not included in the formularies given by Ribot. It depends upon the temporary mood or condition, good or bad, fortunate or unfortunate, of parents when they became such. "A good initial heredity," says a writer, "may produce virtue in the descendants by predisposition merely from a temporarily ennobled nature, although there was in general vice in the parents, and so a bad direct heredity. If you are in a lofty mood Providence is on your side; but, when a drunkard, on the one hand, or when, on the other, a man generally temperate, but in a temporary debauch, places himself under the power of this law of heredity, the specific or initial principle acts just as surely to produce an inheritance

of evil as it does in the opposite case to produce an inheritance of good."

Such are the formularies which experience has shown to include most of the phenomena of heredity; and they may be regarded as so many fragments of a single law, of which we are sensible, but which we cannot rightly understand. The empiric formularies already referred to may be further reduced to *mediate* and *immediate* heredity, and thus, instead of regarding heredity as from one generation to another, we may regard it as embracing a much larger cycle. That heredity thus embraces cycles is amply shown amongst the lower animals, although no instances of alternate generation are known amongst vertebrates.

With regard to cases of reverisional heredity, when the grandson resembles the grandfather, the grandnephew the granduncle, the intermediate stages being totally unlike either, the phenomena may be explained by the fact that these resemblances have been preserved in the *latent state* by the intermediate generations, and then what appears to be mediate heredity is really immediate. Latent characters are "those secondary characters of each sex which lie dormant in the opposite sex, ready to be evolved under peculiar circumstances."<sup>1</sup> The law of heredity is in latent, albeit not in patent, action. This latency or dormancy of ancestral qualities, that afterwards wakes again to open activity, is proof that the effect of the union of two persons may be to hold special qualities of each other in a sort of neutralisation or check, released from which they show themselves again, just as an element in a chemical compound exhibits its own properties again as soon as it is free.<sup>2</sup>

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<sup>1</sup> Ribot.

<sup>2</sup> Dr. Maudsley.

Darwin says we are obliged to admit that certain characters, aptitudes, and instincts may remain in the latent state in an individual, while yet we are unable to find any trace of their presence ; thus may the above resemblances be explained. These latent characteristics of heredity are peculiarly applicable to what may be termed "heredity occurring at corresponding periods," which may be explained on the hypothesis of latent characteristics contained in the individual, in the germ state, and which come to light only under definite conditions, at some particular point of his development, and this particular moment corresponding with a similar moment in the progenitor.

Ribot thus graphically says :— " Still it is evident that these formulas cannot pretend to give a complete explanation of a fact so abstruse and so complex as hereditary transmission. Our only purpose is to show that the term is taken in too narrow a sense when it is restricted to two generations, and that the facts seem less strange so soon as we grasp them as a whole. We desired also to exhibit the wonderful tenacity of heredity. Its law is absolute transmission ; and, in spite of all the obstacles which tend to weaken or destroy it, it struggles on without truce or pause, losing much of its strength as it advances, dissipating itself, so to speak, so as to appear no longer to exist, and yet, when we see the same characters reappear, sometimes after a hundred generations, here is, indeed, matter for reflection. It may be said that heredity verifies in its own way the axiom—Nothing is lost. With its character of unconquerable firmness, of obstinate persistency, it appears to us as one of those many inflexible bonds by which omnipotent nature imprisons us in necessity."

Having thus far briefly considered heredity in its physiological aspect, I now purpose to glance at its psychological bearings and influence, and shall first premise that between physiology and psychology there exists not only an intimate correlation, but an exact parallelism. The brain is the organ of the mind, and thought is but the result of brain-action ; the brain as regards its size, structure, and qualities is hereditarily transmissible ; therefore, we are warranted in asserting that every mental or intellectual state is conditioned by a pre-existing physiological state, and that psychological heredity has its source in physiological heredity. That this is so is proved by the fact that the nervous system is the physical condition and antecedent of those phenomena denominated mental and moral ; and that their interaction and interdependence is such that every variation in the one necessitates a corresponding variation in the other: in other words, between the phenomena, arranged into two groups, as physiological and psychological, there are intimate relations, whether of "invariable co-existence or of invariable succession." The one set we call physiological, when we regard them through the senses and from *without*; the other psychological, when we regard them through the consciousness and from *within*. Just as it would be impossible to think without a brain, so every mental effort or condition necessitates a corresponding state of the nervous system, and every state of the nervous system re-acts proportionately on the great nerve-centres.

Dr. Carpenter says : "Every kind of activity peculiar to a living body involves a change of structure: and the formation of the newly-generated tissue receives such an influence from the conditions under which it originates, that all its subsequent activity displays the impress. Hereditary

transmission of psychical character presents itself under circumstances that entirely forbid our attributing it to any agency that can operate subsequently to birth, and which it would seem impossible to account for on any other hypothesis than that the formative capacity of the germ determines the subsequent development of the brain, as of other parts of the body, and (through this) its mode of activity, in accordance with the influences under which that germ was first impregnated. And thus what we speak of as the 'original constitution' of each individual is in great part (if not entirely) determined by the conditions, dynamical and material, of the parent organisms." When alluding to the physiological aspect of heredity, I traced its origin to the fusion of two simple cells, in which were enshrined all its mysteries. But how manifold do these mysteries appear, when, in tracing the source of its psychological aspect, we find it emanating from the same cells. Not only the characteristic physical structure in its every detail, but the mental and moral nature and character are evolved in and transmitted by the fusion of these two infinitesimal cells! Here is, indeed, a mystery: that by this simple, but occult process, is evolved and transmitted not only the physical, intellectual, and moral likeness of the parents, but of their ancestors, modified not only by the natural tendency to variation which is developed in every child, but by the actual physical and mental condition of the parents at the time of procreation.

Science, as before remarked, can only record and interpret phenomena and experience; and although the facts of heredity are indisputable, the ultimate causes remain as inscrutable as ever. She has, therefore, grouped certain phenomena under the name physiological, and others under

the name psychological, but in doing so she has been actuated more by a desire to facilitate the study of the phenomena which the terms respectively represent, than from any intention of erecting a barrier between them ; for who can define where physiology ends and psychology commences? Like all other groups of natural laws, physiology and psychology are simply terms used to denote the groupings of certain phenomena, which experience has enabled us to perceive are reducible to law ; but to deny the interaction and interdependence of all natural phenomena would be simply absurd, and a violation of that unity which the greatest and most cultured minds have ever observed in Nature. Physiology and psychology I therefore regard as representing simply different aspects of man's individuality ; and, as in the one, so also in the other, the facts of which they consist are those with which Science concerns herself in the light of human experience. Beyond phenomena and experience, she can only concern herself with hypothesis ; and this latter mode of inquiry is unavoidable when we seek for knowledge of causes ; for though "science begins with the investigation of laws, it is perfected only in the determination of causes"—secondary and immediate from necessity, and involving merely "invariable antecedents."

The respective phenomena of physiology and psychology may be grouped into two sets—viz., the first external and unconscious, the second internal and conscious ; but it must be conceded that there is an intimate correlation between the two, inasmuch as every mental condition implies and necessitates an antecedent physical condition, as, for example, in the case of pain, as cited by Ribot, where "this sum of states of consciousness is accompanied by certain states of the organism, motion, play of the

physiognomy, states of the viscera, and *vice versa*." The physiological phenomena, therefore, may be regarded as concerning unconsciousness ; but between the two there is an intimate interaction, interdependence, and correlation-ship, whether of "invariable co-existence," or of "invariable succession." The psychological phenomena associated with automatism are a further proof of the argument : thus, with regard to the spinal cord, which is the nerve-centre presiding over reflex action, the reflex phenomena are not only automatic, but unconscious and co-ordinated : so also the medulla oblongata, a still higher centre, which governs such phenomena as respiration, deglutition, coughing, sneezing, yawning, and the like, and for the most part unconsciously. Proceeding still higher, the cerebellum, whose office it is to preside over the co-ordination of the muscular contractions which produce the various movements of the body, acts quite unconsciously : and lastly, the brain proper itself, which also is capable of acting unconsciously, as is well attested by the interesting phenomena of somnambulism, ecstasy, catalepsy, etc., which have been grouped together under the term "unconscious cerebration." Analy-sing still further, we find that instinct, memory, habits, the emotions, all have their origin in the "dim region of the unconscious," and, further still, that "every mode of intelligence has its unconscious form," even to the grandest efforts of the imagination. "As for the will," says Ribot, "it derives ultimately from character, and the root of character is in the unconscious."

I must here content myself with the simple enumeration of these facts, as arguments, not to say proofs, would take a volume for their consideration. What I am anxious to convey is that physiological and psychological phenomena,

instead of being distinct and different, are really so intimately correlated, and interdependent that the higher may be regarded as simply a development of the lower, and that while "there is no mode of mental activity which may not be produced under its unconscious form," for every conscious form there is a corresponding unconscious one. "The phenomena which constitute physical and mental life, taken in their totality, seem to form a continuous series of such a nature that at the one extremity of the series all is unconscious and purely physiological, and at the other end all is conscious and purely psychological; and that the transition from the one extreme to the other is performed by insensible gradations, whether it be that the unconscious rises to the conscious, or that the conscious returns to unconsciousness. The purely physiological phenomena appear to be reduced in the last analysis to *motion*, and purely psychological phenomena to *sensation*.<sup>1</sup>

From what I have thus far stated it will be seen that the development of the mind depends entirely upon the development of the brain, and that psychological heredity has its source and antecedent in physiological heredity. That this is so will appear all the more evident when we consider that all that we *have* and *are*, as individuals constituted for the performance of certain functions, we owe to heredity, with the exception of the developing influences of our "environment" through life, and the educational processes to which we have been subjected. For if mental development is ever, and in all cases, subject to organic conditions, as it undoubtedly is; and if, with the organism, the nervous diathesis and structure of the parents are inherited—their mental capacities and peculiarities must

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<sup>1</sup> Ribot.

be similarly transmitted. Just, in fact, as the qualities of a plant are transmitted in its seed, so, not only the physical, but the mental characteristics of the organism are transmitted from parents to their children. Moreover, the brain, which I have denominated the organ of mind, is, as Dr. Mortimer Granville says, "composed of nerve cells and fibres, the latter serving to communicate, and the former being endowed with the power of receiving and recording the impressions produced by external objects through the senses, together with such conceptions of impression as are evolved in the course of the operations of thought. No intellectual function is performed, or sensation experienced or imagined—in short, nothing takes place in the mind, or within the range of the perceptive faculties—without a *physical* change in the minute structure or organism of the brain, and the physical changes so produced are the records which form the bases of memory. . . . More than this, as family likeness is perpetuated from parent to child, the brain, with its characteristic properties, will be reproduced, at least, so far as to give an inherited bias to the mind of posterity. It is in this way mental constitutions are transmitted, and tendencies to the commission of crime or the practice of virtues, special powers of work or particular incompetencies and neuroses are transmitted also." We thus see that the embryonic vesicle contains not only the formative capacity of reproducing the physiological likeness of the parents, but the potentiality of developing their modes of thought and action—their character, their powers of reasoning, their intelligence.

I shall now pass briefly in review those psychological phenomena<sup>1</sup> which are subject to heredity, and which, in

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<sup>1</sup> Summarised mainly from Ribot.

fact, constitute the psychological life of man as contrasted with his purely organic or physiological functions. If we are to accept Mr. Herbert Spencer's dictum that "No thought, no feeling, is ever manifested save as the result of a physical force," it naturally follows that without a nervous system no psychological act or function could be performed. At all events, it will be well to remember that the brain is the organ of the mind, and thought its function ; that the physiological phenomena of heredity are conditioned by unconsciousness, and the psychological by consciousness, and that without physical organisation there is no consciousness : so that whilst we admit, as Smee says, that "the human mind cannot understand how a material organisation may produce, or be associated with, consciousness, so we are compelled to declare that consciousness is not manifested without a material mechanism."

Passing towards the conscious from the unconscious, I proceed to notice the heredity of instincts, which I assume to be identical with intelligence, save in degree. Instinct has been defined by Hartmann as "an act conformed to an end, but without consciousness of that end." Ribot says : "Instinct is intended to signify the automatic, almost mechanical, and probably unconscious action of animals, in pursuance of an object determined by their organisation and specific characters." And lastly, Darwin says : "An action which we ourselves should require experience to enable us to perform, when performed by an animal, more especially by a very young one, without any experience, and when performed by many individuals in the same way without their knowing for what purpose it is performed, is usually said to be instinctive." However unsatisfactory these definitions may be as such, they each manifest the

distinction between instinct and all other psychological phenomena, and if we remember that instincts appear as perfectly developed in those animals possessing them from the moment of their birth, whereas intelligence represents the aggregate of successive experiences ; that the one is almost immutable and stationary, whilst the other is variable and progressive—we shall at any rate be able to distinguish between the two sets of phenomena. Beyond all doubt, however, instincts, however defined, are hereditarily transmissible, as the psychical as well as the physical nature are unquestionably transmitted from parents to their children. As surely as the entire range of animal life up to man himself is possessed of, and actuated by, instincts, so surely is this immense range subjected to the laws of heredity, and this fact is so self-evident as to be universally recognised and admitted. I have just said that instincts are almost immutable, but they are not quite invariable, as the action of external circumstances and domestication tend to modify them to some extent ; and, as showing the potency of heredity, even these acquired modifications are undoubtedly transmitted, of which fact I might easily quote many instances. It is important to remember, however, that there is a great difference between the heredity of natural and that of acquired instincts ; for whilst that of the natural instincts admits of no exception, that of the modifications must have become persistent, and assimilated by the organism—in a word, automatic, before they are inherited.

In the light of the evolutional theory “heredity is one of the essential factors of psychological development ; and so mighty and supreme is its influence that it not only preserves instincts, but also creates them.” In this light instinct is to be regarded as “an unconscious form of intelligence deter-

mined by the organisation :" and this latter fact is accounted for by the intimacy of relationship existing between the physiological and the psychological constitution of every animal. Whether instinct results from organisation exclusively is not so well established as the fact that it depends on organisation ; for the former concerns that "mysterious transition from the purely organic to the mental life by means of reflex action, which is principally physiological, and of instinct, which is principally psychological"—a transition so subtle and indefinable that we can neither say where physiology ends and psychology begins ; nor even imagine *how* purely physical life evolves itself into mental life. As sharing the alliance between instinct and intelligence we have only to remember that, in addition to the conscious action of the mind, there is also an unconscious action of far wider range, and that it is possible that the phenomena of instinct, sensation, perception, memory, etc., are alternately conscious and unconscious. The phenomena of somnambulism are well known, during which state the somnambulist will carefully perform any acts which are habitual to him, albeit instinctively and unconsciously. The phenomena of habit, also, resembling instinct so closely, manifest similarly the transformation of intelligence into instinct. The character of innateness generally associated with instinct, does not constitute an absolute distinction between instinct and intelligence if we do not fail to recollect that many instincts are acquired, and that, according to the evolutional theory, all instincts are only hereditary habits. "Although," as Ribot says, "intelligence is, as a rule, conscious, it may also become unconscious and automatic, without losing its identity. Neither is instinct always so blind—so mechanical as is supposed—for at times it is at fault. . . . It is

difficult to believe that the loftier instincts of the higher animals are not accompanied by at least a confused consciousness. There is, therefore, no absolute distinction between instinct and intelligence ; there is not a single characteristic which, seriously considered, remains the exclusive property of either. The contrast established between instinctive acts and intellectual acts is, nevertheless, perfectly true, but only when we compare the extremes. As instinct rises it approaches intelligence ; as intelligence descends it approaches instinct. This must not be forgotten ; and while differences are borne in mind, the resemblances also must be noted."

As to the origin of instincts the Darwinian theory accounts for them, as it accounts for the formation and disappearance of species, by spontaneous variations, the struggle for life, natural selection, time, and heredity ; regarding instincts, as they now exist, as very complex, and formed by the gradual accumulations of the two latter factors. As Darwin has studied principally the physiological phenomena, so Mr. Herbert Spencer has devoted himself to the psychological aspect of the question, and seeks to describe the evolutional process which has deduced complex from simple instincts by heredity and selection. Assuming the unity of composition of psychological phenomena, he regards instinct as representing one of the first stages in the ascending evolution of mind. In the faculties of instinct, memory, reason, etc., he sees only "a convenient way of grouping and naming phenomena, but no real difference. These phenomena form a series in which there are only insensible transitions from class to class. In this ascending series instinct occupies an intermediate place between reflex action and memory ; instinct may be regarded as a sort of organised memory, and memory as a sort of nascent instinct."

This theory of the origin of instincts is inseparably related to the origin of species, and although Darwin has elaborated his grand scientific hypothesis with the utmost skill and ingenuity, Science cannot yet be said to have solved the question as to the origin of species, and until she has done so, if she ever does, opinions will differ as to whether instincts should be regarded as a sum of hereditary habits. "Should Darwin's doctrine be confirmed," says Ribot, "it must then be admitted that all instincts have been acquired, and that what is now fixed was at first variable; that all stability comes from heredity, which conserves and accumulates; and that, in the formation of instincts, heredity is supreme." It is still, however, impossible to say whether an instinct is the result of hereditary habit, or "a primitive, natural, and irreducible fact." There is, indeed, no means of determining which view is correct.

The sensorial qualities—the modes of sensorial activity, in a word, the perceptive faculties—are undoubtedly transmissible, and therefore subject to heredity. This is unquestionable so far as concerns not only specific qualities, but in everything regarding race or variety; it is, therefore, only in relation with individuals that any doubt can arise. Ribot asks the following question: "Is the transmission of secondary and individual characters governed by the same heredity which governs the transmission of the perceptive faculties, in their essential and fundamental features?" Facts can alone reply; but I hope to show that "heredity is usually the rule, even with what is individual, anomalous and capricious." A brief consideration of the special senses will now be necessary, and, as generally enumerated, these consist of five—viz.: touch, sight, hearing, smell, and taste—although a sixth, repre-

senting a mode of sensation without any special organ, and described as a vital or internal sense diffused over the whole body, by means of which we are sensible of what takes place within us, is now generally recognised. Sensation is said to consist in the mind receiving, through the medium of the nervous system, and, usually, as the result of the action of an external cause, a knowledge of certain qualities or conditions, not of external bodies, but of the nerves of sense themselves, and these qualities of the nerves of sense are in all different, the nerve of each sense having its own peculiar quality. Smell, sight, and hearing depend for their manifestation on the existence of a special nerve for each ; whereas taste appears to be a property common to branches of two nerves, and touch is not confined to particular parts of the body, of small extent, like the other senses ; on the contrary, all parts capable of perceiving the presence of the stimulus by ordinary sensation are, in certain degrees, the seat of this sense ; for touch is simply a modification or exaltation of common sensation or sensibility. The nerves on which the sense of touch depends are, therefore, the same as those which confer ordinary sensation on the different parts of the body.<sup>1</sup>

Touch may be regarded as the universal, fundamental sense possessed by all sentient animals, as Mr. Herbert Spencer has ably demonstrated how the other senses, by evolution and specialization, could have arisen from the sense of touch. Tactile sensations, and the sensations of temperature, are alike subject to heredity. Prosper Lucas says that “parents transmit to their children the most singular perfections and imperfections of touch. There are, probably, in the skin, no modes of hyperæsthesia, or

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<sup>1</sup> Kirkes' Physiology.

of anæsthesia, that could form an exception to this rule." The relative susceptibility and insusceptibility of some individuals and families to tickling is well-known, and the numerous idiosyncrasies as to contact with silk, cork, woollen clothing, etc., need only be mentioned. These are unquestionably hereditary. The hand itself—the very organ of touch—is affected by heredity. For as Mr. Spencer has observed: "Large hands are inherited by men and women whose ancestors led laborious lives, and men and women whose descent, for many generations, has been from those unused to manual labour, commonly have small hands." A predisposition to left-handedness is also transmissible, as the writer can prove from the following circumstances connected with his own family. For at least four generations there has been a strong tendency to left-handedness in each. Thus, my paternal grandfather, who was an excellent sportsman and a first-rate marksman, shot from the left shoulder, as I do myself! In each of the four generations, some member, or members of the family, showed the strongest tendency to left-handedness; and during my childhood my left arm was bound up for weeks, but all to no purpose: *Natura non nisi parendo vincitur!* Still more curious is the fact that my sisters' children manifest the same tendency.

With regard to sight—"the most intellectual of all the senses"—its varieties depend on mechanical causes, and on anæsthesia or hyperæsthesia of the nervous apparatus of vision, and all anomalies are hereditarily transmissible. Amongst those peculiarities dependent on mechanical causes may be included strabismus, myopia, and presbyopia: these are all markedly hereditary. Ribot says: "Anæsthesia of the nerves of sight is transmissible in all its grades, and in

all its forms. It is a well-known fact that the sensibility of the eye to light is very different in different persons. It may vary as much as 200 per cent., and, of course, will pass through all the intermediate degrees. Heredity transmits these inequalities, from partial to total anaesthesia, or blindness, when the eye, incapable of noting form or colour, has only an indistinct perception of light. Congenital blindness may run in families. Blind persons will sometimes beget blind children. . . . Amaurosis, nyctalopia, and cataract in the parents may become blindness in the children; and such transformations of heredity are not rare in animals." Daltonism, or colour-blindness, is well-known to be hereditary, and an example is quoted by Darwin, wherein in eight families, akin to each other, this affection lasted through five generations, and extended to seventy-two individuals. Hyperæsthesia of the optic nerve frequently produces, in some persons, great acuteness of vision, so extraordinary, indeed, as to be almost regarded as supernatural. Several examples of this are recorded by Prosper Lucas, in all of which there was a potent hereditary element. As with all other specific characters, in every species of animals, heredity preserves and transmits a visual apparatus of a structure and optical power peculiar to each; so that there can alone be any doubt with regard to individual varieties, but there are good reasons for believing these also to be transmissible.

Although it would be useless to institute an inquiry as to which of the senses is the most important, since opinions would inevitably differ, yet I cannot be far wrong in asserting that that of hearing is of prime importance, since on it depends not only the possibility of speech and, therefore, thought, but it constitutes the foundation of the science of acoustics, and also of the art of music. Similarly to sight,

which, as we have seen, may be most acute, or so weak as to merge into blindness, so the sense of hearing may include every gradation from the most sensitive and acute to insensitive or deafness. Opinions seem to differ as to whether deaf-muteness is transmissible or not; but Dr. Ménière, whilst admitting, that in some cases, the hereditary element has been admitted, says: "Nevertheless, these facts must be held to constitute a rare exception; habitually deaf-mutes married to deaf-mutes beget children who hear and speak. This is, of course, still more the case when the marriage is a mixed one, that is, when only one of the couple is deaf and dumb—though in this case there are well-attested cases of heredity." As Ribot points out: "The returns of the Deaf and Dumb Institution of London, from its foundation to the present time, are conclusive in favour of heredity. Amongst 148 pupils in the Institution at one time there was one in whose family were five deaf-mutes; another in whose family were four. In the families of eleven of the pupils there were three each, and in the families of nineteen two each." May not the commonly observed non-inheritance of deaf-mutism be explained by the fact that when both parents present the same characteristics, heredity may acquire such power as to destroy itself? In this way Sedgwick seeks to account for the fact that two deaf-mute parents often give birth to children that can hear and speak; but after all, these facts go only to show by what "concurrence of fortuitous circumstances, and accidental causes, nature produces diversity."

I have taken pains to make it clear that hereditary transmission does not entirely verify the truth of the axiom that "Like produces like," which would be a realisation of the unattainable ideal law, but concerns itself specially with the

transmission of functional and organic predispositions or tendencies from the *parens* to the *partus*; and thus, although the vast majority of characteristics is always inherited, as facts prove, yet the tendency to variability which exists, comparatively with heredity in every organic being, necessitates individual differences. This is very clearly stated in the following quotations from the admirable works of two French authors, the first of whom, Dr. Moreau, in his *Psychologie Morbide*, says: "It shows an incorrect conception of the law of heredity to look for a return of identical phenomena in each new generation. There are some who have refused to subject mental faculties to heredity, because they would have the character and intelligence of the descendants exactly the same as those of the progenitors; they would have one generation the copy of the other that went before it—the father and son presenting the spectacle of one being—having two births, and each time leading the same life under the same conditions. But it is not in the identity of functions, or of organic or intellectual facts that we must seek the application of the law of heredity, but at the very fountain-head of the organism in its inmost constitution. A family, whose head has died insane or epileptic, does not of necessity consist of lunatics and epileptics; but the children may be idiots, paralytics, or scrofulous. What the father transmits to the children is not insanity, but a vicious constitution which will manifest itself under various forms, in epilepsy, hysteria, scrofula, rickets. Thus it is that we are to understand hereditary transmission."

So, too, Dr. Morel, in his *Traité des Dégénérescences*, says: "We do not mean exclusively by heredity the very complaint of the parents transmitted to the children, with the identical symptoms, both physical and moral, observed in the

progenitors. By the term heredity we understand the transmission of organic dispositions from parents to children. Mad doctors have, perhaps, more frequent occasion than others for observing this hereditary transmission, as also the various transformations which are exhibited in the descendants. They are aware that a simple neuropathic state of the parents may produce in the children an organic disposition which will result in mania or melancholy—nervous affections which, in turn, may give rise to more serious degeneracy, and terminate in the idiocy or imbecility of those who form the last links in the chain of hereditary transmission."

But to return. Deaf-muteness of the parents may be so metamorphosed in their children as to result in a minimum of hearing, imperfectly-articulate speech, mental dulness and weakness, or even idiocy. Many instances of these facts are given by Menckel, the celebrated anatomist. The main fact, however, which we have to bear in mind, is that all the phenomena of hearing, whether of the nature of hyper-aesthetic or peculiarly acute, or of anaesthetic, or that amounting almost to deafness—with every intermediate grade—are undoubtedly heritable and transmissible in the sense which I have explained. Like all other laws, heredity has its exceptions: thus the comparative infrequency of the inheritance of deaf-mutism. How these transformations or metamorphoses occur is beyond the power of science to say. With regard to deaf-mutism, probably Sedgwick, as is mentioned before, is right in supposing that the prepotency of the same characteristics in both parents, in some mysterious way, neutralises the hereditary element so that they are not transmitted; but, be this as it may, heredity is a law which is always being realised, but never ideally so;

so that whilst always a law, it is always the exception, for although the heredity of the great majority of the characteristics is universally acknowledged, the aggregate of all the characteristics is never realised.

Smell and taste are so nearly related that I shall briefly consider them together. The first of these senses is much more acute in some of the lower animals than in man, and in the latter it is very much a matter of race. Dogs are generally regarded as valuable on account of their acuteness of smell, which is certainly hereditary. This peculiarity is also inherited by all the carnivorous animals, and by numerous insects. The savage races of men may be said to be allied to the lower animals by the peculiar acuteness of smell by which they are distinguished. "In North America the Indians can follow their enemies or their game by the scent, and in the Antilles the maroon negroes distinguish by the scent a white man's trail from a negro's."<sup>1</sup> In fact the whole negro race has this sense extraordinarily developed. Amongst the white races the sense varies, as the others do, in point of sensitiveness or olfactory obtuseness, in every possible degree, and we must all be acquainted with families in which the sense is most acutely developed, and with others who are scarcely able to discern one smell from another. The idiosyncracies frequently associated with the sense of smell are also very interesting ; but whether in the lower animals or in man—whether of the nature of degree or of idiosyncrasy—all the phenomena of the sense of smell, whether innate or acquired, are preserved and transmitted by heredity.

As in the case of smell, so with taste ; its varieties, whether specific or individual, are hereditarily transmissible. Burdach

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<sup>1</sup> *Dictionnaire des Sciences Médicales.*

has recorded some interesting facts connected with the lower animals, and associated with hybridism. Thus he says: "The swine has a very strong liking for barley; the wild boar will not touch it, feeding on herbage and leaves. From a cross between a domestic sow and a wild boar came young, some of which have an aversion to barley, like the wild boar, while the others have a taste for it like the common hog." In the case of man also, many men, individuals as well as families, have a defective sense of taste, whilst in the case of others, the sense may be most sensitive and refined. Some, on the other hand, have an inherent and marked dislike for certain flavours; and all these peculiarities, of whatever grade, are emphatically hereditary. Many facts might be given in support of this latter assertion; also with regard to the transmission of a positive distaste for certain articles of food, as cheese, an inherent liking for vegetable, and repugnance for animal food, or *vice versa*, etc. I have, however, quoted sufficient facts to show that "there is such a thing as heredity of the perceptive faculties, even under the individual form;" and that in animals, "the quantity and quality of the perceptive faculties will be certainly transmitted in their specific form, and very probably, too, in their individual form; therefore heredity is the rule." Whether the highest forms of intellectual faculties and activities are subject to the law of heredity, I shall now proceed to consider.

The functions of the cerebral hemispheres are those of the organs by which the mind (1) perceives those clear and more impressive sensations which it can retain, and according to which it can judge; (2) performs those acts of will, each of which requires a deliberate, however quick, determination; (3) retains impressions of sensible things, and

reproduces them in subjective sensations and ideas ; (4) manifests itself in its higher and peculiarly human emotions and feelings, and in its faculties of judgment, understanding, memory, reflection, induction, and imagination. The organs, therefore, in and through which the mind acts in all these operations are the cerebral hemispheres.<sup>1</sup> The faculties into which the intellect has long been divided consist of memory, reason, imagination, conception, and others ; but, as Professor Bain observes, these are not fundamentally distinct processes, but merely different applications of the collective forces of the intelligence. Still, although we may have no power of memory in radical separation from the power of reason, or the power of imagination ; and as this classification of the faculties is, however, otherwise objectionable, at least familiar, and therefore all the more easily comprehended, I shall more or less adhere to it in considering the heredity of intelligence.

Memory consists in the fact that an image once formed in the brain produces an indelible impression, and may at any future time recur. In other words, "every sensory impression which has been once recognised by the perceptive consciousness is registered in the cerebrum, and may be reproduced at some subsequent time, although there may be no consciousness of its existence in the mind during the whole intermediate period."<sup>2</sup> The terminations of the nerves centrally in the brain are in the grey matter, which is abundantly supplied by blood-vessels. The nervous tubes terminate in contact with cells, in which probably the changes occur which cause the registration of impressions of the external world, and from which their reappearance occurs to

<sup>1</sup> "Kirkes' Physiology."

<sup>2</sup> Dr. Carpenter.

constitute the act of memory.<sup>1</sup> We may compare these records to the markings left on the tin-foil by the needle of the phonograph, or to the characteristic forms in which the constituent particles of different substances arrange themselves in the act of crystallisation. Use whatsoever illustration we may, the fact to recognise is that some change takes place, and that a certainly immeasurably minute portion—a molecule, or a series of molecules—of the brain is cast in a special form by every act of brain function ; and being so left, remains the register or record of the impression, the thought, or the impulse by which it was produced. Two obvious inferences result from this explanation. First, there must be a limit to the brain-work possible in a lifetime. The mass of available molecules may be inconceivably vast, but it is certain that a period will arrive when every page, so to say, will be occupied, and then the brain will neither take in nor give out anything new. Secondly, no thought, or word, or feeling, can be unimportant or without its influence on the mind and character, because it leaves an indelible record behind.<sup>2</sup>

If we bear in mind that as in the physical, so also in the mental world, nothing is lost or perishes—nothing that exists can ever cease to be—we may perceive that the phenomena of memory are capable of being explained by the great universal law of indestructibility of force—of the conservation of energy ; nay, more, the production of the phenomena of consciousness is shown by the physiological study of perception to be subject to the law of the transformation of force. As to what it is that survives our perceptions and ideas, it is difficult to determine ; but as it may be assumed that “every

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<sup>1</sup> Smee.

<sup>2</sup> Dr. Mortimer Granville.

mental act leaves in our physical and mental structure a tendency to reproduce itself, and that whenever this reproduction occurs the tendency is thereby strengthened—so that a tendency often reproduced becomes almost automatic,”—the least objectionable term for that which survives our perceptions and ideas is probably that of *residuum*, which only indicates an unquestionable fact of our mental life. Nay, more, it may be asserted that “the relation subsisting between the actual perception and the *residuum* is the relation between the conscious and the unconscious,” as between these two worlds there must exist such a correlation that to each mode of the one a mode of the other corresponds. As Müller says: “Forgetfulness means that the idea of a thing is in equilibrium with other ideas, and recollection that this idea quits the state of equilibrium, and enters the state of motion. No idea is lost; and every operation of the mind, in virtue of which a latent idea passes to the active state, is a state of recollection.”

Memory may also be regarded as a form of habit, for if in tracing the evolution of mind we go “from instinct, which is automatic, to reason, which is so no longer, we may say that memory is the transition from perfect to imperfect automatism. If we trace it in the reverse direction, then memory indicates the moment when what was free and conscious tends to become unconscious.” Indeed, heredity itself may be said to be a specific memory, being to the species what memory is to the individual; and the “heredity of memory is implied in physiological heredity.” Dr. Maudsley says: “The permanent effects of a particular virus, such as that of variola or syphilis, in the constitution, shows that the organic element remembers, for the remainder of its life, certain modifications it has received. The manner

in which a cicatrix in a child's finger grows with the growth of the body, proves, as has been shown by Paget, that the organic element of the part does not forget the impression it has received. What has been said about the different nervous centres of the body demonstrates the existence of a memory in the nerve-cells diffused through the heart and the intestines, in those of the spinal cord, in the cells of the motor ganglia, and in the cells of the cortical substance of the cerebral hemispheres." Is memory, then, in its individual form hereditary? The facts in the affirmative are comparatively few, for obvious reasons, and principally because the study of mental heredity has hitherto been sadly neglected. There can, however, be no doubt that the heredity of the memory is implied in physiological heredity, as what is true of part must also be true of the whole. Hereditary idiocy is characterised by excessive weakness of memory, "idiots generally recollecting only what concerns their tastes, their propensities, their passions. But as this is doubtless the result of the feebleness of their sensorial impressions, this heredity is the effect of a more general hereditary transmission." Even history affords but few marked instances, but there can be no doubt that artists, whether pictorial or musical, must inherit, respectively, a good memory for forms and colours, and for sounds; and as a matter of fact these have been transmitted through four or five consecutive generations. "It must be admitted," says Ribot, "that there are not many facts to show the heredity of memory; but the conclusion is not thereby justified that this form of heredity is rarer than others. The opposite opinion is still tenable, and the lack of evidences can be explained. Memory, with all its undoubted usefulness, plays in human life, and consequently in history, only a secondary and

obscure part. It produces no work, like the intellect and the imagination, nor does it perform any brilliant actions like the will. It does not give material evidence of itself, like a defect of the senses. It does not come under the ken of the law, like the passions ; nor does it enter the domain of medicine, like mental disease. Since, then, it is so little tangible, the lack of evidences need not surprise us ; and there is still reason to hope that, in proportion as the subject of mental heredity, hitherto much overlooked, is better studied, attention will be directed to this matter, and will abundantly show that here, as elsewhere, heredity is the rule."

Chiefly concerning fictitious instead of real objects, the Imaginative faculty may be said to differ in its character in some respects from that of Reason ; yet in both the same powers are exercised, though in a different manner. The Imagination, then, depends upon the intellectual powers for all its higher operations, and is usually recognised to be of a twofold character—viz., reproductive and creative, both of which are hereditarily transmissible. Perception and imagination being correlated so intimately, we can readily understand the transmissibility of the latter ; and besides the first and instinct, imagination, as a faculty of the mind, is more commonly transmitted than any other. We are here more intimately concerned with the creative or active form of imagination—"the imagination which creates and interprets an ideal conception by means of sensible forms"—in a word, the imagination of poets, painters, musicians, and scientists. Of the four subjects just mentioned, whilst the imagination of all is emphatically hereditary, the families of poets are, perhaps, more comparatively rare, and this is scarcely to be wondered at when we remember that

the physiological conditions necessary for the development of a painter or musician are not necessary to the same extent, at least, for the cultivation of the poetic faculty. Thus the painter must have an innate gift for colour and form, and the musician an innate gift for the appreciation of the most exquisite varieties and combinations of sound; and thus the talent of the artist or the musician must depend more on the conformation of the organs than that of the poet. The history of art, however, shows unmistakably that this active or creative imagination, whether of poets, painters, musicians, or scientists, is hereditarily transmissible, and it would be an easy task to cite very numerous instances in proof of the assertion. Suffice it to say that as the result of an examination of the families of fifty-one distinguished poets, twenty-two of them have had one or more distinguished relatives. Amongst painters, whilst we have in England the Landseers, and in France the Bonheurs, Galton found, in a list of forty-two painters of the highest rank, Italian, Spanish, and Flemish, that twenty-one had illustrious relatives. Of musicians, the Bach family is, perhaps, the most distinguished instance of mental heredity on record. In this family alone, of whom Fétis mentions fifty-seven members, twenty-nine are described as *eminent* musicians. The Bendas, Mendelssohns, and Mozarts afford also numerous instances. These facts put it beyond all doubt that the imaginative faculty is potentially transmissible by heredity.

Having thus far considered the heredity of perception, memory, and imagination, I must now inquire whether the remaining faculties of the mind—which concern themselves with abstract and general conceptions—are subject to the same law. “Are they higher,” as Ribot asks, “like the

lower modes of intellect transmissible? Are our faculties of abstraction, judgment, ratiocination, invention, governed by heredity, as are our perceptive faculties? Are common sense, insanity, genius, talent, subtlety, aptitude for abstract studies, hereditary?" As the unity of the intellect is recognised and admitted by all schools of thought, and as facts undoubtedly prove the heredity of the lower intellectual modes, it must follow as a natural sequence that all the higher forms of the human intellect are also subject to this law. However deeply we inquire into the ultimate nature of intellect, we must accept either one or the other of the two following conclusions: We must either hold, with the materialists, that it is *phenomenal*, the cause being the organism; or with the idealists, that it is *noumenal*, the effect being all that exists or can be known. The materialistic argument is as follows:—"If thought is only a property of living matter, then, as heredity is one of the laws of life, it must therefore be also one of the laws of thought; or, in more precise terms, intellect is a function whose organ is the brain; the brain is transmissible, as is every other organ, the stomach, the lungs, and the heart; the function is transmissible with the organ; therefore intellect is transmissible with the brain. Physiological heredity involves, as a necessary consequence, psychological heredity in all its forms."

In contradistinction to this theory is that of the idealists, who hold thought to be the only reality, and who, with Schopenhauer and his school, discover in will the first cause of all things, the supreme reality. Like all other systems, this "must account for the world of sense, for nature, and her phenomena and laws. There being no other absolute existence, save thought, matter must be referred to thought."

It must admit the material world, with its laws, as a purely phenomenal existence, and this admission enables us to see that the opposition between the materialistic and idealistic theories is by no means so radical as it would at first appear, and that there is a possible reconciliation between the two. Schopenhauer and his following believe that "there are two distinct modes of existence ; the noumenon in the will, and the phenomenon in the intellect and in nature. To the mind, regarded as noumenon, none of our conceptions of laws, logical necessity, or categories, are applicable, for all this only pertains to the mind considered as phenomenon. Consequently, since we restrict ourselves to the study of experience—that is to say, of facts and their laws—there can be no disagreement between us and the idealists. The difference between us springs, not from any diametrical opposition of doctrine, but from the fact that to the study of phenomena, which both sides pursue, and to which we strictly confine ourselves, the idealist joins a metaphysical theory, which, in our eyes, has no scientific value, since it transcends science. . . . If the idealist admits, as he does, that in the order of physical, chemical, physiological, and psychological facts there are co-existences and sequences that can be reduced to fixed formulas, he has no fair ground for refusing to concede to heredity a place among these empiric laws, though he may deny that it applies to the intellect considered as noumenon." The real nature of thought itself baffles all scientific definition ; for "although it explains all things, it does not explain itself ;" although, by its means, we may be enabled to solve the mystery of the universe, it remains in itself a mystery and insoluble. The unity of the intellect being, however, beyond doubt, nothing could be less rational than to imagine

that any intellectual modes of activity are specifically beyond the laws of heredity. As scientists, we are only concerned with the interpretation and recognition of facts, and with experience, so that with regard to reason—as to the nature of which even metaphysicians are themselves by no means agreed—no possible theory can invalidate, or even oppose our premises, for “the world of pure reason begins only where the world of phenomena ends”—and thus the scientists and metaphysicians have each separate provinces. Cousin and Reid define reason as “an impersonal, universal, and necessary” faculty; but can we not say as much of heredity? These characters being the same “everywhere, always, and in all men,” they are, therefore, specifically characteristic, and such specific characteristics without exception, it is the province of heredity to transmit; thus, according to this definition of reason, “no faculty of man is more certainly transmissible than the highest form of intellect—reason. For heredity, too, is impersonal, since it preserves the species; and universal, since it governs the whole domain of life; and it is one of the forms of inflexible necessity.” If we, therefore, regard intellect and reason from a transcendental point of view, they transcend experience; but if we consider them phenomenally, there is no reason why they should be exempted from the law of heredity. Our contention that the human intellect, even in its highest forms, is hereditarily transmissible, in order to be justified should be supported by numerous facts; these indeed are forthcoming in abundance, but for a detailed list of instances of intellectual heredity among men of science, philosophers, political economists, historians, critics, novelists, etc., I can only refer the reader to the evidences given in Ribot’s splendid work.

With regard to the heredity of the sentiments and passions, Ribot says : " Man is situated in the midst of the universe, which acts upon him only by its properties. Colours, odours, savours, forms, resistances, movements, become modes of our organism, producing therein a shock to the nerves. Then all these peripheric impressions pass to the brain, probably into the optic thalami, and being thence transmitted to the cortical substance of the brain, they are transformed, we know not how, into facts of consciousness ; the physiological phenomenon becomes psychological, constituting that state of the mind which we denominate cognition. But this is not all. The nerve-vibrations produced by material objects, not only make us acquainted with something outside of us, but they also produce within us a certain agreeable or disagreeable state, which we call feeling." If there were no such reverberation of pleasure or pain within us, then our experiences of the external world would be, as Bichat says, " only a frigid series of intellectual phenomena. . . ." If we add that pleasure and pain may be excited in us either by some state of our organs dependent on the vital processes, or by recollections suggested by memory, we have enumerated every mode of cognition which can produce phenomena of sensation.

Philosophical physiologists, such as Bain, Müller, and Maudsley, agree in regarding Spinoza as the author of the grandest contribution to the philosophical study of the ultimate reason of sensible phenomena ; and, in his admirable *Ethics*, the latter author contends that the ultimate explanation of all sensible phenomena is found in the fact of desire—" desire meaning appetite with self-consciousness," and appetite being " the very essence of man, in so far as it is directed to acts which tend towards his conservation."

The law of self-conservation has been thus formulated by Bain : "States of pleasure are connected with an increase, states of pain with an abatement, of some or all of the vital functions ;" but the cause of the two states is desire, as it is just because there are in us tendencies that may be satisfied or appeased—that we feel pleasure or pain. In fact, when we experience pleasure or pain, we wish to preserve the one and destroy the other. In this law of pleasure and pain, we have the key to the leading varieties and expressions of the feelings, and it is named the law of self-conservation, because without it the system could not be maintained, for, as Bain says : "Inasmuch as we follow pleasure and avoid pain, if pleasure were injurious and pain wholesome, we should incur entire shipwreck of our vitality, as we often partially do, through certain tendencies that are exceptional to the general law." The law of pleasure and pain we regard therefore as fundamental: the law that connects pleasure with increase of vital power; pain with the diminution of vital power. In fact we may look upon this law as, in many respects, the foundation, the main-stay of our being; it is the principle of self-conservation—the self-regulating, self-acting impulse of the animal system.

"The phenomena of the affections," says Ribot, pertain to our inmost being. By this fact of cognition the outer world is let in upon us, and is reproduced in miniature, for thought is nothing but existence arriving at self-consciousness; but our feeble personality is associated with this impersonal state by the pleasures and pains it produces in us, for sensation and volition make us what we are. The modes of sensibility are so intimately connected with the organs, and with the whole constitution that, *a priori*, we might conclude that they are transmitted by heredity." The

following facts will tend to show whether they are, or are not hereditarily transmissible.

Buffon says: "A horse that is naturally vicious, sulky, and restive, will beget foals with the same character;" a fact of which every horse-breeder is well aware.

Girou de Burzareingues says: "Heredity may, even in animals, extend to their most whimsical peculiarities. A hound taken from the teat, and bred far away from either parent, was incorrigibly obstinate and gun-shy in circumstances where other dogs were easily excited. When a bystander expressed his surprise, he was told that there was nothing remarkable, 'his father was the same.'" I might readily quote other and numerous instances bearing upon the no less striking transmission of characters when races and species are crossed, but I shall content myself by observing that all such evidence of the heredity of propensities, instincts, and passions in animals, tends to show that the same qualities are hereditarily transmissible in man, as it does not necessitate the superficial explanations drawn from education, example, habit, and all the external causes which have been supposed to do duty for heredity. In man, the universal consciousness of existence—that inner sense of touch whereby we are cognisant of the state of our organs, of the tension or relaxation of our muscles, of the state of weariness, pleasure, etc.,—is undoubtedly transmissible, and the heredity of certain strange propensities, instincts, and dislikes, may be referred to such an unconscious mode, underlying all consciousness and all thought. Thus also may be explained the idiosyncrasies of families and individuals as to the untoward effects of certain drugs, etc. Montaigne, as is well-known, had an invincible repugnance for medicine of every kind, and this he asserts was

inherited, in both direct and indirect lines, through many generations of his family. In connection with thirst, hunger, and sexual appetite, innumerable instances might be given as to the heredity of dipsomania, gluttony and eroticism, so also with the more complex passions as gambling, avarice, theft, and murder, all of which are unquestionably subject to the law of heredity.

In proceeding to briefly consider the heredity of the Will, I must be careful in the outset to define what I mean by the term, and to guard myself from all metaphysical discussions about free-will and heredity, which have caused so much wrangling amongst philosophers and theologians. Still, concerning myself with phenomena and experience—the true domain of science,—and having already considered the contemplative faculties of the mind, as to their heredity, I am now anxious to show that the active faculties of mind, as represented by the term Will (and all that it implies), are alike subject to the law of heredity.

“The will, volition, or voluntary action is,” says Bain, “on the outside, a physical fact. Animal muscle under nervous stimulation is one of the mechanical prime movers; the motive power of muscle is as purely physical as the motive power of steam; food is to the one what fuel is to the other. The distinguishing peculiarity of our voluntary movements is that they take their rise in *feeling*, and are guided by *intellect*; hence, so far as will is concerned, the problem of physical and mental concomitance is still a problem, either of feeling or of intellect. There are three elements in the will: (1) the spontaneous energy or surplus activity of the system; (2) the fundamental law of pleasure and pain, and (3) a large superstructure of acquired connexions between feelings and specific movements. With regard to the first,

involving the disposition of the moving organs to come into operation of themselves previous to and apart from the stimulation of the senses or the feelings—the activity being increased when such stimulation concurs with the primitive spontaneity—I think there is evidence so show that the profuse activity attendant on health, nourishment, youth, and a peculiar temperament called the active temperament, springs in a very great degree from inherent active power, with no purpose at first, but merely to expend itself, and that such activity gradually comes under the guidance of the feelings and purposes of the animal. It is the surplus nervous power of the system discharging itself without waiting for the promptings of sensation. In the course of education the spontaneity is so linked with our feelings as to be an instrument of our well-being, in promoting pleasures and removing pains. The voice, by mere spontaneity, sends forth sounds; the ear controls and directs them into melody, and the wants of the system generally make them useful in other ways.

Mere spontaneity, however, would not give us all that we find in the impulses of the will. Being the overflow of vital power, it would show itself only whenever and wherever there is such an overflow. We want a kind of activity that shall start forth at any time when pleasure is to be secured, or pain to be banished, and that shall be directed to the very points where these effects can be commanded. This power is exemplified in the fundamental law of pleasure and pain to which I have already referred. Such I conceive to be the groundwork of volition, greatly, but never entirely, overlaid in mature life by a process of education or acquirement.”<sup>1</sup>

In dealing with the heredity of the will the analytical method hitherto pursued, concerning the heredity of instinct,

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<sup>1</sup> Professor Bain’s “Mind and Body.”

perception, imagination, memory, intellect, sentiments and passions, will no longer suffice, for with men of action and resolute will-power the play of the various faculties must be simultaneous—their processes essentially synthetic, action alone is their end, theory but a means. Thus they are characterised by immense resolution and great strength of will, always exercised, and by the qualities which this implies —viz., boldness, courage, self-confidence, and mastery over the timid and irresolute. “Like every other faculty, strength of will may be hereditary.” Voltaire thus writes of the Guises: “The physical, which is ‘father of the moral,’ transmits the same character from father to son for ages. The Appii were ever proud and inflexible; the Catos always austere. The whole line of the Guises was bold, rash, factious, full of the most insolent pride, and of the most winning politeness. From François de Guise down to that one who, all alone, and unexpectedly, put himself at the head of the people of Naples, they were all—in look, courage, and character—above ordinary men. I have seen full-length portraits of François de Guise, of Balafré, and his son: they are all six feet high, and they all possess the same features; there is the same courage, the same audacity on the brow, in the eyes, and in the attitude.” “We know not,” says Ribot, “how the will is thus transmitted; but when we see that its energy and its weakness are connected with certain states of the organism, and that physical strength commonly renders men bold and courageous, while physical weakness makes them timid, we can scarcely doubt that this transmission takes place by means of the organs, and that it is in fact physiological.”

Statesmen and soldiers afford the best examples of those in whom the active faculties of the mind, represented by a

vigorous will, are generally found in their highest development, and of those who, *ceteris paribus*, would be likely to transmit their extraordinary will-power to their descendants. History affords many illustrious examples: for instance, amongst statesmen the Guises, the Medicis, the Foxes, the Peels, the Pitts, the Sheridans, and the Walpoles; amongst distinguished soldiers Alexander the Great, Bonaparte, Charlemagne, Coligny, Gustavus Adolphus, Hannibal, Maurice of Nassau, the Napiers, etc., etc., enough at any rate to disprove all idea of accidental coincidence.

I may here allude briefly to the influence of heredity in the formation of national character, in contradistinction to that of individuals; and it is indisputable that, as in a family, heredity transmits and perpetuates certain physiological and psychological characters, so it transmits and fixes the physiological and psychological characteristics of peoples and nations. The character of a nation is but the aggregate of the characters of the individuals composing it, and it consequently follows as a logical sequence that what is thus true of individuals, must also apply to the nations which they compose. The virtues and vices, the strength and the weakness, the success or non-success of a nation is after all but the reflex of the national character; and we must regard physiological and psychological laws as the great factors in the building up of every character, whether individual or national. The institutions of a nation are the outcome of the people's conduct and religious beliefs: "their manners and creeds are the effect of their character. The character produces the institution, and they in turn form the character; thus, after several generations, the two are but one, the institutions are but the character rendered visible and permanent." "Still," as Ribot continues, "we must

not forget that the institutions are only an external cause, which is sustained by an internal cause—character—and this is transmitted hereditarily. And as a people is perpetuated by generation ; as it is a law of nature that like shall produce like ; as the exceptions to this law tend to disappear when large masses, instead of particular cases, are examined, obvious facts point out how national character is preserved by heredity."

If we examine carefully the history of any nation, we cannot but become impressed by the light it throws upon the causes which have led to the people's progress or decline ; and these causes undoubtedly have their origin and development in the national character. How tenacious national characters are may be seen from the history of the ancient Greeks, Byzantines, and modern Greeks. "Thus," says Ampère, "amid all these vicissitudes, the fundamental character of the Greek has not changed ; he has now the same qualities, the same defects, as of old." And as showing how native characters and habits have been transmitted, I need only point out that the Arcadians "still lead a pastoral life ;" whilst their neighbours, the Spartans, "have a love for fighting, and an excitable, quarrelsome temper." Surely the following description of our French neighbours, from the pen of Julius Cæsar, is as characteristic as if written in the nineteenth century. "The Gauls," he says, have a love of revolution ; they allow themselves to be led by false reports into acts they afterwards regret, and into decisions on the most important events ; they are depressed by reverses ; they are as ready to go to war without cause, as they are weak and powerless in the hour of defeat." The history of every nation affords much information as to the part played by heredity in the formation and perpetuation of

its national character, and even when different nations are crossed by inter-alliances—as sometimes happens for their weal, and oftentimes for their woe—however the national character may be thus modified, heredity is the power which either conserves their greatness, or ministers to their decline; for it is inexorable in its results. The development of the highest civilisation is, perhaps, unattainable without that complexity and variability of elements which are only to be found as the results of appropriate international fusion ; and thus development and progress become possible ; but in the case of even the most exclusive nations, such as the Jews, the Gypsies, and the Cagots—however their development is retarded by their exclusiveness—the evolution and fixation of their national characteristics is primarily the result of heredity.

The individuality of man consists in his differentiation from every other individual—has its source and origin in heredity, and the modifying principle of variability to which every individual is subject, and is furthermore developed and intensified by the results of his environment in the struggle of life. As no two leaves in a forest are precisely alike—as no two human faces, however similar, are the exact likeness of each other ; so no two individuals who have ever existed have been identically the same, either in physical conformation, or in mental qualities, or moral character. Physiologically, we have seen that whilst the external and internal anatomical conformation and organic peculiarities are marvellously transmitted from one generation to another in their minutest details, also the peculiarities of expression, gait, voice, size, skin, hair, nails, and everything pertaining to the functions which constitute the physical life of man ; and whilst also, pyscho-

logically, we have seen that instincts, sensorial qualities, memory, imagination, intellect, sentiments and passions, and even the human will—everything, in fact, relating to man in his dynamism—are alike subject to heredity, yet the tendency to variation, co-existing with heredity in every organic being, necessitates the differentiation of individuals, and renders the ideal law of heredity unattainable and impossible.

Regarding a man microcosmically, *i.e.*, trying to analyse his individuality as to what he *is* and *has* organically and dynamically, we find him evolved from an embryonic vesicle, the joint production of his parents. Here his individuality commences. But this same embryonic vesicle has the formative capacity of transmitting with him, not only the physical, mental, and moral nature of his immediate progenitors, but also some peculiarities of their ancestors for probably many generations, so that the source of some of his physical, mental, or moral peculiarities may have been transmitted from a remote past. This is indeed a mystery, before which Science stands baffled and appalled ! The fact, however, is indisputable. In the brief first stage of life of the unborn—in addition to the diseases developed in the body while it is still in the womb of the mother (to which I shall refer anon)—there occur to the body affections which exercise an influence over its individuality, and which leave impressions that last throughout the after-life. Bearing with him, then, a physical, mental, and moral nature, consisting of qualities, ancestral, paternal, and maternal, he is at length ushered into the world, and from the moment of his birth is subjected to the circumstances constituting his environment, amid which his struggle for existence must be fought, and amid which he must be to some extent victorious if he survives. But, analysing his individuality still further, we find that what

we have hitherto defined as physiological and psychological may be further subdivided into temperament, idiosyncrasy, diathesis, and hereditary predisposition: the first "applicable to the sum of the physical peculiarities of an individual, exclusive of all definite tendencies to disease;" the second, "a peculiarity of an individual, usually rare, which does not necessarily entail any degree of proclivity to disease, but which may become obvious under a variety of exciting causes;" the third, "a bodily condition, however induced, in virtue of which the individual is, through a long period, or usually through the whole life, prone to suffer from some peculiar type of disease;"<sup>1</sup> and the last, any varieties of the three former when transmitted from parents to children.

The following table will show at a glance the various factors of individuality, which characterise every individual in different degrees:—

Ancestral	...	Qualities—physical, mental, or moral	Inherited.			
Parental	...	Qualities—physical, mental, and moral				
Maternal	...	Qualities—generated during uterine life				
Modifications effected by natural variability...Inherited.						
Ancestral and Parental.	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="flex-grow: 1;"> <div style="display: flex; justify-content: space-between;"> <div>Temperament</div> <td>...</td> <td>...</td> </div> <div>Idiosyncrasy</div> <td>...</td> <td>...</td> </div> <div>Hereditary predisposition...</div> </div>	...	...	...	...	Inherited.
	Diathesis	...	Inherited or acquired.			
Modifications effected by his environment } acquired. during the life-long struggle for existence						

When it is remembered that every individual is subjected to each and all of the foregoing influences, and that each one of us has inherited certain peculiarities—physiological, psychological, and pathological—which we, in turn, shall pass on to our descendants, the reason is not far to seek as to why every individual differs from every other, or why those

<sup>1</sup> Mr. Jonathan Hutchinson.

peculiarities which distinguish us from one another in health should also tend to modify or intensify our relative proneness to certain morbid affections, by the neutralisation or development of the morbid susceptibilities or predispositions which have been transmitted to us. The physical likeness transmitted by parents to their children is never exact. This is sufficiently evident in features, size, weight, and all that concerns external conformation. But, as Sir James Paget says : "If we could be exactly endoscopic, we should observe equal variation within ; the same want of exact likeness in liver and lung, and, I venture to say, in blood, and lymph, and plasma, and whatever goes to make up the *whole person*, healthy or diseased. The inheritance of likeness in disease, or liabilities to disease, is indeed clear evidence of the transmission of likeness in the very minutest part of structure and composition. But the likeness is never perfect ; it may in different persons deviate this way or that ; it may vary towards disease, or back again towards the healthy type ; but it is never perfect, and, in successive generations, its degree of unlikeness may in some persons increase to a great width of difference." We thus see that however perfect the likeness transmitted from parents to their offspring, it is never either organically or dynamically exact, and however closely the *partus* may resemble the *parens* physically, mentally, or morally ; however closely the former may resemble the latter with regard to temperament, idiosyncrasy, diathesis, and hereditary predisposition, yet each child preserves its own individuality, by reason of the differentiation produced by natural variability, to which every organic being is subjected, in addition to heredity.

I have now to consider the pathological aspect of heredity or the influence of the hereditary element in disease. Let

me begin by defining our terms. Pathology (literally, *a discourse on pain*) may be defined as the science which treats of the origin, nature, course, and causes of those changes in the body which constitute disease, or as the physiology of disease. What, then, is meant by the term *disease*? "By disease is understood some deviation from the state of health ; a deviation consisting for the most part in an alteration in the functions, properties, or structure of some tissue or organ, owing to which its office in the economy is no longer performed in accordance with the normal standard."<sup>1</sup> Diseases are generally regarded as consisting of two classes—viz., *organic* and *functional*. The terms health and disease are alike relative and indefinite ; neither health nor disease being separable from each other by any hard and fast line, and the one passing into the other by insensible degrees, just as physiology passes insensibly into psychology. Disease is then, generally, an abnormal performance of the vital processes *nutrition* and *function*, the latter being especially dependent upon the state of the former. When, therefore, both of these processes are normal, the condition is one of health ; when abnormal, one of disease. Diseases are, therefore, not entities, but mere groups of modifications of structures already in existence, and of actions always progressing in a vital system. They are, in fact, particular conditions of the living body—new phases of its vital manifestations—whether of the nature of functional derangements, or of organic or textural degeneracy. Sir John Forbes says:— "All morbid action is but a modification or perversion of some natural or normal action or function ; and all the physical results constituting morbid structural alterations are mere perversions or modifications of natural or normal

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<sup>1</sup> Green's "Pathology."

textures, or, at most, analogous textures fabricated from the same materials by like processes." Not only in epidemic diseases, but in all diseases, whether acute or chronic, it is a matter of universal and daily observation that the phenomena and results of disease are very much modified by the difference of individual constitutions: and to this difference must be attributed the special character given to the same malady in different individuals, as, owing to this cause, we find the same diseases, under precisely similar treatment, at the same time exhibit phenomena, progress, and events entirely different.

We have already seen that the differentiation of individuals intimately concerns not only their physical nature and functions, but also their mental qualities and moral character. Let me briefly inquire how this individuality affects the morbid processes, whether functional or organic; to which we are all more or less liable, and to some of which, in the natural course of events, we must all succumb. As, in general terms, all that we *have* and *are* we owe to heredity, with the exception of the modifying influences to which we are subjected in "the struggle for existence," so, as each of us has inherited a certain physical, mental, and moral constitution, whether healthy or otherwise, and differing from that of every other individual, it follows that this individual differentiation, physical, mental, and moral, predisposes us, each one more or less, to certain morbid processes and influences, differing in each as to symptoms, intensity, course, and mode of termination. As, in fact, the physiological and psychological nature of every individual—*inherited and acquired*—differs from that of every other, so, too, must every individual differ from every other as to his pathological predisposition. For example:—

Disease germs pass into each of us every day ; but the soil must be suitable for them to germinate or they produce no effect ; even when they do germinate the product varies according to the soil, and, as Sir James Paget says : “The study of this soil—this living soil—is yet more necessary in respect of diseases which come in part, or wholly, by inheritance : *for it is in each as personal and distinct as any other constituent of personal character, and the study of it must be intimately personal, with an exact analysis of every disposition to disease.*” This brief quotation expresses my argument most pithily, for if it means anything it surely means that the individuality of each human unit differs from that of every other, and that by reason of this individual differentiation—herited and acquired—every individual is variously affected by morbid processes and influences. Would that this great fundamental truth were more frequently recognised and more highly appreciated by the members of our profession, for in no other way can we get rid of that bane of modern practice—routine treatment—which is neither more nor less than unworthy empiricism !

What is meant by predisposition ? It may be defined as a sort of neutral state, between health and a state of functional derangement and disease, consisting in a tendency or liability to, without the actual existence of, derangement or disease. It might be subdivided under four heads—viz. : I. Hereditary ; II. *Ætal* ; III. Sexual ; and IV. Acquired. With regard to the first, as children resemble their parents, physically, mentally, and morally, so their constitutional peculiarities, and the morbid tendencies growing out of them are also unquestionably inherited. As a general rule, diseases themselves are not inherited (as we shall see presently), but only those structural or constitutional peculi-

arities which predispose to them. Sometimes, indeed, the hereditary predisposition is so patent (as frequently seen in pulmonary and brain affections) that, notwithstanding the fact of every effort being made to prevent it, the disease becomes fully developed ; and, just as in physiological heredity, certain characters or peculiarities remain latent during an intermediate generation, so also the potency of atavism or reversional heredity is frequently seen to influence similarly the phenomena of disease. I shall, however, refer to this question more in detail in the course of these papers. Predisposition is also ætal, or connected with the age of individuals, and is most remarkably displayed in infancy for the following reasons : The skin and mucous membranes of infants are remarkably delicate ; they are characterised by a high degree of sensibility or capacity of sensation, also of contractility or capacity of contraction : the size of the head is large in proportion to that of the body : they are exposed to the irritation of dentition ; and they have little power in maintaining the external heat. After the first dentition to the sixth or seventh year is a period of great excitement of the nervous and vascular systems, and characterised by a predisposition to febrile and inflammatory affections, also to those of an exanthematous character. From this up to the age of puberty—a period of comparative health—the eruptive or exanthematous predisposition continues, to which may be added a liability to epistaxis, and, at puberty, those constitutional derangements especially affecting females, in connection with their uterine functions and allied conditions. From puberty to manhood—twenty-four or twenty-five years of age—is a dangerous period, usually characterised by a strong predisposition to tubercular and scrofulous diseases, haemorrhages, and digestive dis-

orders. The physical and mental health being once confirmed, remains most vigorous from the twenty-first to the fortieth year, and the body has then a greater power of adapting itself to surrounding circumstances. From the forty-fifth to the fiftieth year, in females, there is a tendency to disease or derangement of the reproductive system during the menopause, and, in both sexes after the fiftieth year there is a loss of strength, certain functional disturbances, a liability to tissue-degeneracy, and decrease of organic power. There is, then, as Tanner says, "A predisposition to various organic diseases; the brain, heart, and the genital and urinary organs being especially prone to suffer. As senility advances sensibility decreases, the memory fails, the muscular strength becomes diminished, and gout, calculous affections, apoplexy, paralysis, softening of the brain, etc., often supervene to hasten on the period of second childhood to its close. Age has a very important influence on the same disease occurring in persons of different ages, especially beyond the middle period of life, for whenever the vitality of the body, or its different parts, is lessened, then nature is of course less able to cope with the disease than in young and vigorous subjects. This is well seen in fevers."

Predisposition is also sexual. There are affections which appertain peculiarly to males, and others to females, from the difference of organisation of the sexes. Burns, speaking of Nature, says:—

"Her 'prentice hand she tried on man,  
And then she made the lasses."

and when contrasted with man, there can be no doubt that she has made use of finer materials in their manufacture; for females have, as a rule, a much greater delicacy of the skin and mucous membrane, and a higher degree of sensi-

bility and contractility. So, if we contrast the diseases to which females are specially liable with those occurring more characteristically in males, we shall find the former far more liable to those of an asthenic type than are the latter. Men are more subject to fatal inflammatory attacks than women ; they are also more intemperate, and more exposed to violence and accident. Women, owing especially to the fact of their having a uterus, are far more predisposed to nervous affections than men are, and the causes which usually produce inflammation in men, will frequently, in the case of women, merely give rise to functional disturbance. The uterus and its functions, however, give rise to diseases and disorders in women, from which men are happily free ; for, during maidenhood there are either excesses, deficiencies, or other irregularities or complications associated with menstruation, and during matronhood, pregnancy, delivery, lactation, and menopause give origin to a "sea of troubles." Practically, however, the great point to be remembered is that whilst in man diseases and derangements of a sthenic character are more frequently observed, in women they are usually characterised by asthenia and want of tone and vigour in the nervous system.

Predisposition may be acquired by a number of agents, which operate either externally or internally upon the body. A disorder or disease once affects the body, and having been removed, leaves behind some weakened part, some latent fault, which, though not seen under the tranquil state of the body, becomes disorder or disease when the body receives a shock. The weak part sustains all the injury when any exciting cause operates on the body. Thus, again, the habits of life, mode of living, and nature of occupation, are amongst the most powerful predisposing causes of—or safe-

guards against—disease. So also are climate, temperature, moisture of atmosphere, and impurity of air. On these, however, I shall not now dwell, as strictly speaking, in discussing the hereditary element in disease, I should have limited my observations to hereditary predisposition alone ; but as the whole subject is too often lost sight of, I may be excused for the few remarks I have made on the ætal, sexual, and acquired sub-divisions. Speaking of predisposition, Dr. Armstrong says :—“ This tendency seems to have performed a very conspicuous part of ancient pathology, and is, in my opinion, by far too much neglected by practitioners in the present day. . . . The doctrine of predisposition is of the greatest importance in a preventive point of view ; and if we take the whole of its sources and trace them through society, we shall find, that in the civilised world at least, scarcely an individual can be said to be physically sound. We shall find in almost every person that there is some latent fault, which may become disorder or disease when such an occasional agent or cause is applied as will disturb the body, either generally or locally.” Predisposition, in fact, consists in a peculiar state of the physical and mental constitution of every individual, which renders him specially liable to suffer injuriously from the effects of certain morbific agents ; and when these latter are of a “ non-specific ” type, predisposition will determine the particular disease which it shall induce in each of several individuals similarly exposed to it ; whilst, in the case of a “ specific ” agent or “ morbid poison,” it determines the relative liability of several individuals similarly exposed to it, to become the subjects of the particular diseases it is capable of originating, and also influences the severity of its attack.<sup>1</sup> Thus, let us suppose several persons equally

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<sup>1</sup> Dr. W. B. Carpenter.

exposed to the effects of a chill : some will be found to suffer no injurious consequences, but one will develop an attack of pneumonia, another of bronchitis, another apoplexy, another nephritis, another jaundice, another gout, another acute rheumatism, another gastro-intestinal derangement, and so on according to the individual predisposition of each person. So also, let us imagine several individuals equally exposed to the influence of some morbid-poison, as of cholera ; similarly we shall find that, owing to relative insusceptibility, some of them will pass unscathed through the ordeal ; others will develop a severe or fatal attack of cholera ; others will probably only suffer from diarrhoeic symptoms, with gastro-intestinal disturbance ; and, again, others from vomiting, cramps, and characteristic evacuations.

In analysing a man's inherited individuality we have seen that it depends upon natural variability, and the transmission of ancestral, parental, and uterine influences ; also that these inherited qualities may be subdivided into temperament, idiosyncrasy, hereditary predisposition, and diathesis. How do these latter affect the predisposition to disease in individuals ? Temperament, as I have already stated, has nothing to do with disease in itself, being a part of the inherited physical and mental constitution of every individual, irrespective of any morbid tendencies ; but that it becomes an important factor in predisposing to disease will be seen from the following facts. It should be here remembered that the temperaments, sanguine, nervous, lymphatic, biliary, however well-defined, are seldom or never seen in their ideally perfect state, for as individuals differ from each other in every respect, what is true of the whole must also be true of its parts ; therefore, as a matter of fact, every individual presents an intermingling of temperaments in different

degrees, and thus we see that however potentially temperament predisposes to diseases, its potentiality will vary with the individual. Whilst the temperaments are thus generally "mixed," it will usually be found that one especially prevails, and may be thus said to characterise the individual. The modifying influences of the temperaments in disease may be thus briefly stated. The sanguine temperament predisposes to disease characterised by the rapidity of the inflammatory process, and predisposes its possessors to acute affections which develop themselves regularly and completely, deservces rapidly, and generally with well-marked symptoms of crisis. Such persons are especially liable to plethora, congestions, inflammations, haemorrhages of an active character, gout, and inflammatory fever. The nervous temperament predisposes to disorders of the nervous system, convulsive diseases, various congestions and haemorrhages, hepatic and internal obstructions, neuralgia, insanity, and melancholia. The diseases to which the lymphatic temperament predisposes are generally of a chronic character, and of an asthenic type, as debility, tuberculosis, scrofula, and dropsy; and the temperament itself is usually associated with an inferior power of resistance to attacks of acute disease, and is characterised by adynamia or slowness of the nervous and circulatory systems, and by retardation or deficiency of the general assimilative functions. The bilious temperament tends to dyspeptic affections, hypochondriasis, and hepatic derangements generally. It should, however, be remembered that however highly we may estimate the influence of temperaments in predisposing to disease, they themselves are capable of being altered in character by age, habit, and external circumstances, and by the physical and mental changes originating in disease or accident. The tempera-

ment of any individual may be modified also by suffering, indulgence, moral control, or religious enthusiasm, and thus the more we analyse the microcosm of man, the more we are astonished by the infinite and ever-increasing differentiation of individuals.

Idiosyncrasy is also a factor in predisposing to disease, but may likewise become an agent in producing the very opposite condition—viz., insusceptibility. Idiosyncrasies are invariably congenital, and the term is never applied to those peculiarities which have been acquired. There can be no doubt that they depend upon peculiarities of physical structure, however impotent we may be in seeking to demonstrate their physical cause. As to their real nature I regard them—with Mr. Jonathan Hutchinson—as “diatheses, or parts of diatheses, developed, intensified, and specialised by hereditary transmission,” as, in fact, “diathesis brought to a point,” and the very acme of individuality, for how often do we see such constitutional peculiarities, in certain individuals, so intensely developed as to render their eccentricity especially striking, if not manifestly absurd? The phenomena included under the term I am now discussing are variously developed in different individuals, but whilst some of them may be neutralised, or otherwise modified by age and circumstances, all are inherited—usually last during the whole period of life, more or less—and are almost invariably transmitted. Idiosyncrasies, like the temperaments, do not necessarily entail any proclivity to disease, but may variously predispose to certain morbid processes, as, for example, the specific or exanthematous fevers. In the case of one, such an extraordinary immunity may be revealed that the specific virus may produce no apparent effect; whilst in that of another, such an incredible

degree of susceptibility may be manifested, that the virus may run riot in his system, producing symptoms of the utmost violence and intensity. There is at most very little proof for the assertion that the specific animal poisons vary in their intensity to any great degree, but at any rate such variation counts for very little when compared with that manifested in different individuals exposed to the influences of the same epidemic, and under similar circumstances. Scarlet-fever, small-pox, typhus and typhoid, diphtheria, erysipelas, syphilis, carbuncle, tetanus: how variously are different individuals affected by each of these? Not one, but many volumes might be written as to the agency exercised by idiosyncrasy in predisposing to, and modifying disease, but I shall conclude my observations on this interesting subject by quoting from Mr. Jonathan Hutchinson, who has done so much to throw light upon the influence of heredity in disease, and who says:—"If we fail to recognise, or if we forget, the influences of idiosyncrasy, we shall not only waste much time in our processes of clinical research, but we shall be in constant danger of coming to wrong conclusions by declining to accept evidence as to cause which is really sound, and of adopting false principles in reference to treatment. In every example of a curious and unexpected form of disease, our minds should, I think, first ask the question, 'How much of this may possibly be due to the individual peculiarities of its subject?' We are often on a wrong track if we seek to make external influences explain the whole. It seems to me of great practical moment that the individual peculiarities of all patients should be carefully studied and that they should themselves be made intelligently acquainted with them. There are few of us without our idiosyncrasies, and their variety is innumerable."

Diathesis may be defined as a term denoting a morbid proclivity existing in an individual or family in consequence of his or their heredity and environment; or, still better, as "any condition of prolonged peculiarity of health giving proclivity to definite forms of disease." Mr. Hutchinson says: "What we mean by diathesis is little other than an exceedingly chronic disease. It is a disease or taint which lasts a lifetime, which may be active at times, and latent at times, and which may be handed on to another generation." Diathesis may be either inherited or acquired—may be permanent or transitory, or intercurrent with healthy intervals. The term, strictly speaking, should never be associated with any transitory condition of health which may pass away without leaving any permanent impression upon the system, for persistency to some extent is invariably implied by it. It is also necessary to distinguish between the terms dyscrasia and diathesis, for, whilst the former signifies actual bad health, the latter simply implies a morbid proclivity which may be possessed by an individual who is seemingly quite well.

As to the causation of diatheses, it is well to remember that as the health or unhealth of races, families or individuals, is dependent upon transmitted tendencies, owing to the action and interaction of the law of heredity in their progenitors, and also upon the action of circumstances upon themselves, the morbid peculiarities whose general phenomena are grouped under the term diathesis, must depend entirely upon the same causes. These exist hereditarily in the individual, and, in the acquired form, in the circumstances of his environment—the latter also accounting for the development of those which have been inherited. I shall now very briefly consider the classification of the diatheses, or those types of morbid proclivity which dis-

tinguish individuals, and the due recognition of which so intimately concerns the processes of disease and their treatment.

To supply any adequately satisfactory classification of the diatheses is simply an impossibility, owing principally to the facts that our present knowledge of them is far too vague and imperfect, and that their relative differentiation is very frequently dissimilar in kind. It would be easy enough to classify diatheses under such heads as temporary and permanent—acquired and inherited, but in such a classification it would be often necessary to place the same morbid condition under more than one class, which would, therefore, lead to confusion and complexity. I shall, therefore, whilst glancing at the classification of the older writers, materially adopt that of Mr. Jonathan Hutchinson, which is formed on a more scientific basis, and bears more particularly upon the life-history of pathological processes. In the text-books of a few decades ago we find the recognition of the following diatheses—viz., the gouty, rheumatic, cancerous, tubercular, and strumous. The two first are still recognised, but the third is now acknowledged to be a dyscrasia rather than a diathesis, and the two last are generally associated together, as consequences of inflammatory action in predisposed individuals. Curiously enough, Professor Laycock (to whom we owe so much in everything pertaining to the differences between man and man), in enumerating his classification of the diatheses, gives the following—viz., the arthritic, the strumous, the nervous, the bilious, and the lymphatic. Dr. Milner Fothergill follows suit. But, to my mind, both of these authorities are mistaken in mixing up temperaments with diatheses, and in not estimating the differences between them. For, as the temperaments are purely physiological,

and involve no tendency to disease, the diatheses, on the other hand, are purely pathological, and consist essentially of a morbid proclivity. Thus the last three diatheses mentioned in this classification should be relegated to the temperaments, as they concern only the physiological differences between man and man, and do not necessarily imply any predisposition to disease.

It may be here mentioned that whilst we regard a diathesis as a constitution of body which, in the course of life, at various periods, and under varying circumstances, will give rise to local or general diseases, characterised by a common resemblance, either as to their etiology, symptoms, or pathology, and thus constituting a unity, yet the various diatheses, owing to the action and interaction of heredity and environment, combine with each other in various degrees, and thus result in complex or composite diathetic varieties. For like heredity, without evolution, if the diatheses were transmitted without variability, they would be indefinitely inherited with the same specific characters, which we know would not be in consonance with natural law. And thus, in practice, every day of our lives, we meet with patients who, while they afford us typical examples of this or that diathesis, yet reveal the elements of others in various degrees. As the so-called laws of Nature represent merely the grouping of certain phenomena, so diathesis may be regarded as the grouping of certain constitutional peculiarities, having certain pathological tendencies, in certain families or individuals; and, as every individual differs from every other, in every respect, we must naturally be prepared to admit a similar differentiation with regard to his diathetic peculiarities. Diatheses are, in fact, but rough types of constitutional peculiarities, showing a predisposition to

certain diseases, and which may be variously blended in different individuals, whilst the original type is more or less preserved. I now enumerate the classification of diatheses given by Mr. Jonathan Hutchinson, which is as follows :—

The scrofulous or tubercular.....	}	Universal.
The rheumatic .....		
The catarrhal .....		
The malarial .....	}	Climatic.
The bronchocele .....		
The gouty and hæmorrhagic .....	}	Dietetic.
The leprous .....		
The scorbutic .....		
The rachitic .....		
The diathesis of malignant new growths.		
The diathesis of senile degeneration.		
The visceral diathesis.		
Specialised diathesis (chilblains, feeble vascularity, etc.)		

I shall now briefly consider the foregoing diathetic varieties as exemplifying not only the influence of heredity in predisposing to disease, but its power as a factor in differentiating man from man in his morbid predispositions.

*The Scrofulous and Tubercular Diathesis.*—I regard scrofula and tuberculosis as modifications of the same inflammatory process—the former usually resulting in the development of tubercle, although the typical inflammatory process of scrofula may not attain a distinctly tuberculous condition. At the same time, the proneness to tuberculosis may be so potent that it is produced as a lymphatic neoplasm, without an inflammatory exciting cause, and without the occurrence of preceding congestion. In the case of both forms of inflammation a predisposing, as well as an exciting cause, is generally present—the first being hereditary, and the second acquired—and the greater the degree of the former, the less is the need for the latter. Thus we see that as in scrofula so

also in tuberculosis, both are the results of inflammatory action in predisposed individuals.<sup>1</sup>

Beyond a few differences there is nothing in the physical conformation of the scrofulous which does not represent that of the tuberculous. The scrofulous, the rheumatic, and the catarrhal, Mr. Hutchinson regards as the three great universal diatheses to which every individual is more or less subject —the degree of susceptibility varying extremely in different individuals ; and in many cases so great is the susceptibility that in itself it constitutes a very grave and critical disease. The scrofulous diathesis is almost invariably inherited, but is sometimes developed by all those external circumstances which tend to reduce the natural powers of the constitution. This diathesis, whilst it is the parent of many evils, is not in itself so well-defined as others, and is frequently associated with abnormal states of the circulation, which have probably no connection whatever with tuberculosis —*viz.*, the liability to chilblains, swollen lips, etc. The tendency of modern thought is, however, to regard both scrofula and tuberculosis as modifications of the same inflammatory process, and the two diatheses generally associated with them are now regarded as modifications of the same diathesis.

The scrofulous diathesis, whilst ill-defined in itself, is very frequently associated with others, as those of gout, rickets, and goitrous cretins, and, in fact, with all those diathetic predispositions which tend to degeneration of nutrition in general. Although commonly associated with the lymphatic temperament, the latter does not, therefore, necessarily imply scrofula : indeed, scrofula may be well marked in those of the sanguine, or of the melancholic temperament. However little may be known of the real intimate nature of scrofula,

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<sup>1</sup> Mr. Jonathan Hutchinson.

we are at least assured that it is associated with defective vitality ; that it is markedly hereditary, and that its diathesis involves a special predisposition to the many forms of scrofulous or tuberculous diseases.

*The Rheumatic Diathesis.*—Two forms of this diathesis have been described—*viz.*, the vascular, allied to gout, and the strumous, with external characteristics of scrofula ; thus showing that, whilst individuals are very frequently found who are distinct and typical examples of each form of diathesis, in the case of others there will be one diathesis forming, as it were, the basis, and another, or others, superimposed upon it, as, for instance, the strumous and rachitic often possess gouty characteristics. Dr. Laycock gives the following sketch of the physiognomical peculiarities of those possessing the rheumatic diathesis : “They are usually well-built and well-nourished, and the complexion healthy and florid. In those who have the rheumatic cachexia this is not so, being pallid and dingy, often with patches of pigment deposit. In a certain class with tendency to fibroid degeneration there is a yellow bronzing of the face ; the teeth are characteristic, being unusually regular, sound, and firm ; the hair is abundant ; the skin less thin and dry than in the scrofulous form.” This diathesis is distinctly hereditary, and tends to run in families. By this is meant not that the disease itself, but only the family tendency to it, is transmitted—in a word, a greater or less liability to contract it. Dr. Maclagan says “The difference between a rheumatic and a non-rheumatic subject is, that the motor apparatus of the former contains that special ingredient which is requisite to the propagation and action of the rheumatic poison, while that of the other does not. Between the fibrous tissues of the two men there is no difference that

can be detected either by the anatomist or the chemist ; but in the one these tissues afford a *nidus* for the propagation of the rheumatic poison, in the other they do not. In the one the tissues of the motor apparatus contain something which is wanting in those of the other. It is the presence of this something which constitutes the peculiarity of the rheumatic constitution. It is the tendency to the development of this peculiarity which is transmitted from father to son, and makes each generation susceptible to the rheumatic poison."

Although rheumatism when it occurs in the young is usually transitory, yet the individual who has once suffered from an attack will be ever afterwards liable to another, and, as age creeps on, there is great danger that it may become chronic, or even permanent. The rheumatic diathesis is not only found associated with the catarrhal, the scrofulous, and the gouty, but may be modified by any other condition or influence which deleteriously affects the general powers of the system. The rheumatic diathesis becomes so intimately united with the gouty in hereditary transmission that it is frequently impossible to distinguish between them. Although no age is exempt from the development of rheumatism, attacks are most frequent between the ages of sixteen and twenty, and the whole cycle of its operation may be included between the fifteenth and fortieth years. As already stated, previous attacks decidedly increase the predisposition to the disease, and although ill-health, however induced, may predispose to a rheumatic attack, also mental worry or depression, many individuals are attacked when in, apparently, robust health.

*The Catarrhal Diathesis.*—There is an innate proclivity of tissue, which is hereditary, predisposing to catarrhal

affections—in fact, a diathesis, all the individuals who are subject to which are made more or less liable to the protean effects of catarrh, and in very varying degrees. As Mr. Hutchinson, so far as I know, was the first to recognise and describe this diathesis as such, I shall for the most part use his own words in referring to it. Catarrh should be held to imply identity in cause and not similarity in result. By using the word in this sense—*i.e.*, by not simply regarding all those forms of inflammation of mucous membranes attended by free discharge, irrespective of their causes, which are often very different, as catarrhal, we shall find it applicable to other forms of inflammation than those merely of mucous tissues. “In so doing,” he says, “we shall construct a large and perfectly natural group of maladies. Whatever is the result of catching cold is catarrhal; conditions which follow from other and dissimilar causes, however similar their results, ought to be refused that name. The catarrhal diathesis, using the word in this sense, is one of the three fundamental ones. It is not due to any specific or any specialised cause. Every organisation possessing a nervous system must be supposed to be capable of manifesting it, for its essence consists in proneness to inflammatory congestions excited, in a reflex manner, through the influence of cold applied to the surface. The susceptibilities of the nervous system, however, in this respect differ, as we all know well, very greatly in different individuals. These differences are hereditary, and may easily become the possessions of families or of race. Not only do individuals differ in the degree of reflex susceptibility, but they also vary much as to the special tissues or organs which are most prone to suffer under it. Thus, some catch cold, almost solely in the mucous membranes of the nasal passages and

pharynx ; in others, the tonsils, throat, and larynx are more prone to suffer ; in others, the bronchial mucous membrane ; and in others, the stomach and bowels, or even the liver."

I have now briefly sketched the three great universal or fundamental diatheses, to which probably every human being is subject in some degree, and which have been evolved out of the womb of an illimitable past :—which have been transmitted from age to age, and from generation to generation, developed and increased, or modified and repressed, to the present, and which will assuredly, to a great extent, control the health-destinies of generations yet unborn, in the future. Each of them involves a specialised constitution, varying as to specificity in every individual, by means of which each living person is more or less predisposed to the diseases which these diatheses are, respectively, capable of influencing ; and, in the natural history of disease itself, there can be no more interesting or important chapter than that which concerns itself with these diatheses, —so curious in their origin, so complicated in their action, and so inevitable in their results.

*The Malarial Diathesis.*—This diathesis differs from the preceding ones in being generally acquired instead of inherited. At the same time, it may be in some degree hereditary, the transmissible proclivity being in proportion to the severity and duration of the disease in the parent or parents. It is, moreover, difficult to discriminate between what is inherited and what is acquired, as the children of those who have been subjected to malarial influences are generally "born under conditions of continued exposure to its cause." This diathesis may be found associated with any other ; also with syphilis and alcoholism. Of malaria itself we know nothing definitely, as its real nature has hitherto

baffled the combined efforts of medical scientists. Its existence is known to us only by its effect—viz., the production of the various forms of intermittent and remittent fevers. With regard to the real nature of the malarial poison, the most generally believed opinion is that it consists of minute organisms. Thus Niemeyer says:—“I have no hesitation in saying decidedly that marsh miasm—malaria—must consist of low vegetable organisms.” Certain it is, however, that the microscope has not yet revealed them; but as the powers of this instrument are limited, as is the visual power of our eyes, it is not, therefore, fair to assume that such minute organisms do not exist. There is, doubtless, in the personal constitution of certain individuals a peculiarity, differing in degree in each, which predisposes them more or less to the influence of the malarial poison; and once the disease has been excited, subsequent attacks may arise without any exposure to malarial influence, thus proving that its effect upon the constitutions of affected individuals is invariably permanent, and that the individual who has once been subjected to the action of malaria, will not only display susceptibilities as long as his life lasts, but may pass them on to his offspring by hereditary transmission. It must, therefore, appear that the state of body which we name diathesis is capable of being produced by an agent so persistent and permanent in its effects as the malarial poison.

*The Bronchocele Diathesis* is, like the foregoing, dependent upon certain climatic or telluric influences, and may be either hereditary or acquired. Bronchocele or goître consists in hypertrophy of the thyroid gland; but in reality this is merely a prominent symptom of a general morbid condition, which is endemic, and prevails in magnesian-limestone districts. Its predisposing causes are hereditary

tendency, the female sex, and the age of puberty. With regard to its exciting cause, like the poison of malaria, it has never been satisfactorily determined ; but where the disease has arisen without being inherited, the cause can generally be traced to some impurity in the potable water—probably some form of iron. In this country women are far more predisposed to bronchocele than men, and although the disease generally occurs about the age of puberty, it may occur from any age up to forty years ; and children have been born with a thyroid enlargement. Just as malaria belongs to marshy grounds, swamps, and jungles, so the causes of bronchocele are intimately associated with mountains and valleys,—the most common characteristics of the spots in which it prevails being want of due movement in the air, as in deep valleys shut in by mountains. Frequently associated with bronchocele is “that strange and melancholy” form of idiocy or imbecility, called Cretinism ; a condition arising from endemic causes, associated with imperfect development and deformity of the whole body, varying, however, in degree. It is developed under the same conditions as bronchocele ; accordingly it is generally met with in the same localities. In this country it has been observed in the dales between Lancashire and Yorkshire. As in the case of bronchocele, when Cretinism cannot be traced as the result of hereditary predisposition, it will be found to depend upon certain atmospheric and geological conditions, peculiar to special localities. In an endemic disease like bronchocele, where the general health is always in a morbid condition, it seems absurd to associate it only with the enlargement of the thyroid gland, but since it is hereditary, and reveals itself persistently in those families which have once been subject to it, it implies an

innate morbid proclivity, which can only be represented by the term diathesis. Contrasted with malaria, the causes of this diathesis work much more slowly, as a much longer residence in the locality is essential for the production of their effects ; and, for their full development, it appears necessary that hereditary transmission should have existed through several generations.

Mr. Jonathan Hutchinson insists upon the features of distinction between diatheses due to food, and those to be assigned to climate, and says :—" The latter are distinctly restricted and endemic ; the others not so. The latter, when severe, affect all immigrants who come within their range of influence, without regard to health, position, or habits, and under certain circumstances leave scarcely any exempt. The diet-diatheses, on the contrary, as illustrated by leprosy and the like, affect immigrants only very seldom, and with great apparent capriciousness, taking one, and leaving a thousand untouched." I shall now proceed to briefly discuss these diet-diatheses, which constitute a group of great importance, and may be regarded as " persistent constitutional conditions, sometimes hereditary, at others not so, which have their origin in connection with food." There can be no doubt that personal habits as to the use and abuse of certain articles of diet are so capable of modifying the health of individuals, as to produce in them such constitutional conditions as will predispose them to certain diseases, and that this predisposition may become hereditary. We are therefore justified in including these morbid proclivities in the category of the diatheses.

*The Gouty Diathesis* is the first and most important to be discussed in this class, and it is capable of assuming widely different forms, and of causing a vast number of

symptoms, disturbances, and complications. It is distinctly hereditary, and may be acquired. The fundamental fact upon which all theories as to the nature of gout must be founded is that it must be regarded as a constitutional disease depending upon the deposition of urate of sodium in the cartilaginous structures of the joints. The symptoms of gout are too well known to render their recapitulation necessary here, nor do I deem it essential to enumerate the physiognomical peculiarities which may be said to characterise its subjects. The etiological sources of the gouty diathesis may be traced to hereditary transmission, certain errors in regard to diet and drink, and the impregnation of the system with lead. In many cases, however, these causes may be more or less combined. Try as we may to eradicate the gouty diathesis, it will be almost inevitably transmitted for several generations, but as the diathesis is generally intensified by pernicious habits of eating and drinking, it will be readily seen why it becomes so frequently a permanent legacy handed down from one generation to another. Heredity may be so strong in its production, that gout may arise without any further cause, and should the predisposition be very marked, it may even be developed in children, and the younger the subject the more probable it is that there is an hereditary taint. The acquired causes of this diathesis are inordinate or erratic eating and drinking, and due want of exercise. Even in cases in which there is hereditary predisposition, these habits will aggravate and intensify the proclivity. Alcoholic intemperance is also an important factor in the development of the gouty diathesis, and is capable of producing the diathesis *de novo*, in addition to the influence it exerts on any transmitted proclivity. In fact, as Mr. Hutchinson says : "Had mankind continued

to be vegetable-feeders, and never known the use of wine or beer, we should have had no experience of gout." It has been observed that gouty persons are peculiarly susceptible to the influences of lead in the system, as is proved by the fact that medicinal doses of this metal have often been known to induce an attack. Unless very strongly hereditary, this diathesis scarcely ever reveals itself before thirty years of age, and seldom after sixty-five: males, probably owing to the different habits of the two sexes, are, as a rule, much more predisposed than females. Full-blooded, plethoric persons are said to be predisposed, but it should be remembered that these conditions are often produced by the habits which originate acquired gout: formerly this *dominus morborum* was also regarded as *morbus dominorum*, from its being confined to the aristocracy, and to those in affluent circumstances, for obvious reasons, but it is now common enough amongst "people of low degree."

The *hemorrhagic diathesis* is associated with the gouty as effect and cause. When once established, this diathesis is strongly hereditary. It is confined to man, the lower animals being apparently exempt, and has frequently manifested itself during an attack of gout in certain individuals. This diathesis, as Mr. Hutchinson has pointed out, "has its origin in the peculiarities of vascular structure which are developed by gout, and which have become modified and specialised by transmission through many generations." Heredity is, without doubt, the most striking and important of all the predisposing causes of this diathesis. Grandier speaks of it—Hæmophilia—as "the most hereditary of all hereditary diseases;" and so potent is heredity in the perpetuation of this terrible disease, that "it has been possible to construct an actual *family tree of the disease*, with roots

or main branches running back through several decades, or even a century and upwards, and ramifying more or less widely in later times." Whenever this fell disease makes its appearance in a family, other members are almost certain to become affected ; and if we compare the total number of recorded cases with the number of families affected, we shall find that the number of individuals affected bears a proportion of three to one to the families. Sometimes several bleeder-children may be born of parents who have never manifested the disease ; at other times, it becomes developed gradually through a longer period of time, the anomaly starting in a single individual, and descending directly through a series of successive generations. A third, and very important mode of propagation, is by means of indirect transmission. "Thus, after one or more cases of hæmophilia have appeared among the children of healthy parents, the affection is usually handed down, not so much by the bleeders themselves, as by their non-bleeder brothers and sisters ; and this singular mode of transmission of the outward manifestations of the disease may be repeated for several generations."<sup>1</sup> Thus much for the hereditariness of this diathesis.

*The Leprous Diathesis.*—There has been some confusion generated by the indiscriminate use of the two words leprosy and lepra to signify the same disease, whereas the two diseases which they respectively represent are quite distinct from each other. True leprosy is synonymous with elephantiasis Graecorum, and lepra Arabum, but the term lepra as applied by the Greeks represented a disease characterised by scaly white spots on the skin, sometimes erroneously regarded as psoriasis, but which is unquestion-

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<sup>1</sup> Immerman.

ably very different and distinct from true leprosy—a terrible disease—described by Aretæus as so much greater than the rest of diseases, as the elephant is bigger than all other animals—which is generally diffused through the body, involving more or less its every tissue. Leprosy is endemic and hereditary, and amongst the other predisposing causes may be mentioned those which produce scrofula. As to the exciting causes much difference of opinion still exists, the late Sir Erasmus Wilson contending that miasma is the causative agent, while Mr. Jonathan Hutchinson and others believe that the real cause is a poison taken in connection with fish. Certainly leprosy has been known to exist and flourish where malaria is unknown. Mr. Hutchinson thus summarises the evidence which leads him to place leprosy amongst the diet-diatheses:—“It is,” he says, “the same in all countries, and probably has been so in all ages. It is the same in rich and poor, in hot climates, and in cold climates. It is certainly neither infectious nor contagious; yet it is capable of origination in those who go to reside where it is rife. It slowly gets well in those who leave its haunts and reside elsewhere. It is not possible to mention any climatic condition which is common to all the varied localities where leprosy is found. Whenever it occurs in hot climates it usually observes the same rule as it does when occurring in a temperate climate, where it happens to those who are engaged in the fishing trade, and who live, to a very large extent, upon the poorer kinds of fish; yet in hot climates it now and then happens to those who eat but little fish. But this is always under circumstances where fish is known to be bad, and where it rapidly decomposes. Finally, in all temperate climates leprosy disappears before advancing civilisation, the introduction of agriculture and the increase

of population." After these convincing arguments, I feel there is no necessity for me to apologise for having included leprosy amongst the diet-diatheses.

*The Rachitic Diathesis.*—Rickets may be defined as a disease of infancy and childhood, producing distortion of the osseous system owing to a deficiency (or, according to Sir William Jenner, a malposition,) of calcareous matters, and of the more essential matters of the bony structure. The disease is said to be sometimes intra-uterine in origin, but this seems doubtful ; it usually begins, however, soon after birth—frequently from the fifth to the sixth month, and very often makes its appearance first when lactation is discontinued—reaching its climax and subsiding, when, as a rule, milk is no longer given as diet, but the child is allowed to have a variety of mixed food. Although there is some difference of opinion as to whether it is hereditary or not, there can be no doubt, at least, that the state of health and general nutrition of the mother must be ranked as a predisposing cause of great importance. Those who believe in its hereditary nature contend that a diathesis allied to, but not identical with, the scrofulous, is transmitted, but the tendency of general opinion is, that rickets in the great majority of cases is not inherited, nor is it a mode of development of tuberculosis or of syphilis. I shall, therefore, not discuss it further here.

*The Scorbutic Diathesis* is an example of "an acute diathetic disease produced quickly, and quickly cured,"<sup>1</sup> inasmuch as it rapidly subsides and passes away when the supply of improper food on which it depends is withdrawn, and when the deficiency of vegetable food, which is its exciting cause, is supplied. The principal reason for

<sup>1</sup> Mr. Jonathan Hutchinson.

regarding it as a diathesis at all is the fact that, as soon as the acuter symptoms have subsided, it sometimes happens that it assumes a chronic form, associated with permanent ill-health; and not only so, but there is every reason to believe that the modification of health, so induced, may be transmitted by heredity.<sup>1</sup> Although, therefore, scurvy is a disease of comparatively short duration, it is capable occasionally of not only modifying the health, but of transmitting its influence hereditarily; and as its essential cause is as stated, a defective diet, there is every reason why it should be included among the food-diatheses.

*The Diathesis of Morbid New Growths.*—This term is employed by Mr. Hutchinson to denote “cancer in its old and popular sense, as including malignant new growths of all kinds;” and as we have the term carcinoma, as opposed to sarcoma, by which to differentiate certain malignant new growths from others, he regrets that the word cancer is not still retained to designate all kinds of malignant new growths, which, in examining as to diathesis, must all be grouped into one family, so that the individual tendencies to new growths in general should be estimated without over-regarding differences of kind, especially as “some persons display more than one form, and when hereditary transmission occurs it is very common to see it produce a growth of a different kind from the original.” I must be careful to distinguish between the terms diathesis and dyscrasia in relation to cancerous growths, for as the former signifies merely an inherent proclivity to cancer in the tissues, the latter concerns the actual development of cancer in the body, with its associated ill-health. Is there any condition of tissue-health, pre-existing before the actual development

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<sup>1</sup> *Ibid.*

of cancer, which may be said to give proclivity to it? If so, the term cancerous diathesis may be justly applied to such a condition. As Mr. Hutchinson points out, "Cancer in the main is obviously dependent upon age; it is in nine cases out of ten part of senility—a sort of second childhood of the tissues. . . . We shall probably be not far from the truth if we admit senility of tissues, local or general, to be the one predisposing cause of cancer with which we are acquainted: whilst injuries and all forms of local irritation are its exciting causes. A little step further may next be taken in the belief that everything which tends to hasten senility, either local or general, will increase the predisposing influence, and in this category may be placed anxiety, distress, overwork, and excesses of all kinds."

That the development of all malignant tumours or growths is materially influenced by constitutional conditions admits of no doubt; also that neoplastic processes when occurring locally may be, and are generally, modified by the general state of the constitution: moreover, in the case of malignant new growths, this constitutional or diathetic condition is undoubtedly capable of determining the development of the neoplasm. The influence of hereditary predisposition as an etiological source of new growths, is, indeed, all-important: as Dr. Green says:—"The inherited peculiarity is probably, in most cases, a local rather than a general one, consisting in some peculiarity of the constitution affecting the tissues from which the new growths originate, some peculiarity which renders them more prone than other tissues to undergo abnormal development: . . . . the tendency would appear to consist in a predisposition of the tissues themselves to become the seats of new formations." Whether we may agree with Dr. Green or not as to

the local character of the inherited peculiarity, there can at least be no doubt that a morbid proclivity of tissue, predisposing its subjects to the development of malignant new growths, is most frequently inherited—a morbid proclivity, or constitutional peculiarity, which we cannot otherwise regard or describe than as a diathesis ; and upon this constitutional taint or vice the malignancy of these new growths mainly depends. As to whether cancer is really hereditary or not is a matter concerning which there is much difference of opinion, but that it is occasionally so is proved by a case of Dr. G. H. Barlow's, in which a lady was the fifth victim to cancer of the liver in two generations. The deposits which constitute new pathological growths, whether innocent, malignant, or semi-malignant, are only so many evidences of the differentiation of pathological processes in different individuals ; for the predisposition may, in one set of individuals, tend towards the production of tubercle, in that of others to cancer, in others to fibroid tissue, and in others to lardaceous matter : in each case there is an inherent morbid proclivity to one or other of these pathological processes, and in each this constitutes a malignant or non-malignant diathesis, which may be perpetuated by hereditary transmission.

The remaining diatheses may be dismissed in a few words, not entirely because of their comparative, unimportance, but because I feel that I have already dwelt sufficiently upon these deviations from the norm which render individuals different, in a pathological sense, from each other, and which constitute an important element in their individuality. The fact is that no enumeration of the diatheses can be complete, as variation must differ in certainty and extent in proportion to "the mingling of diatheses, and of all dispositions and

liabilities to diseases in transmission from and through both parents. The real point of practical importance is that we should look for indications of the existence in the same person of two or more morbid conditions or dispositions, such as may be derived from both parents, or from several ancestors, and suit our treatment accordingly."<sup>1</sup> As in the temperaments, so also in the diatheses, we seldom or never meet with them in their ideally-perfect form or condition. One may appear especially prominent, but when we recollect and strive to appreciate the action and interaction of all the causes which produce the individuality of man, we shall not be surprised to find evidences of the mingling of diatheses in every individual—an admixture as infinite in degree as in variety.

Of the remaining diatheses, I may just mention the state in which premature senility, as evidenced by such general tissue-degenerations as atrophies, arcus senilis, white hair, pale blood, and general failure of nutrition, amounts to a disease: the heritable condition of skin associated with certain affections, as psoriasis, eczema, acne and lupus; deficiency of nerve tone, which although not a diathesis in itself, yet complicates them all; the hepatic diathesis, as revealed by the subsequent appearance of xanthelasma occurring in various parts of the body in an adult; the diathesis denoted by chilblains, and that in which the vascular system generally is very feeble, resulting in liability to venous congestion in exposed and distant parts, even to gangrene of the extremities.<sup>2</sup>

Such, at least, are some of the morbid proclivities evidenced by patients in daily practice, and which are potential agents in producing and maintaining man's indi-

<sup>1</sup> Sir James Paget.

<sup>2</sup> Mr. Jonathan Hutchinson.

viduality by hereditary transmission. As Dr. Ord says: "In that analysis of the *κρᾶσις* of the individual which must furnish the interpretation of much of his behaviour in illness, the accurate estimation of many combined influences, native and accessory, has been called the stumbling-block of practice. It may better be called the touchstone of practical skill. That physician does well who carries with him a mental picture of some such perfect human animal as Galen has imagined, and who marks on the diagram, with his patient before him, the lines of original shortcoming, of development, of warp, of injury, of degeneration, so as to arrive at some clear sight of the outcome or resultant of all in the present organisation and reactions of that patient." In other words, that physician does best who most carefully appreciates the physiological, psychological, and pathological peculiarities of each of his patients—peculiarities which render each patient different from any other, and which constitute the elements of individuality in every atom of humanity.

It should be distinctly understood, however, that such predisposing causes of disease as temperaments and idiosyncrasies—also those typical proclivities which I have just considered under the term diatheses—however influential as factors in modifying morbid processes in individuals, receive their force and character from heredity, and may thus be said to be merely effects of hereditary predisposition specialised in certain sets of individuals: but hereditary predisposition means far more than the temperaments, idiosyncrasies, and diatheses, for it not only includes all these, but also implies that a morbid predisposition which has arisen in some individual, whether ancestral or parental, has, by heredity, been transmitted to his offspring, and

either intensified by descent, or modified by age, sex, or accessory circumstances. In speaking of diseases as hereditary, we do not mean that the diseases themselves occurring either in ancestors or parents are actually transmitted to their offspring (who under those circumstances would be born with them), but what is really meant is that a certain organic constitution is inherited by the children, which "being likely to undergo that pathological development in the ordinary circumstances of life, is therefore described as a constitutional predisposition or tendency to disease. We do not in the least know what is the intimate nature of the predisposition, but we know that it may be greater or less in different persons, and that it is thought to be so great in the cases of such diseases as epilepsy, phthisis, and insanity, and so likely to be transmitted to children as to be a serious objection, if not an actual bar, to marriage."<sup>1</sup> At the same time it should be remembered that the inheritance of a disease-tendency, however likely, is not invariable; for, as Dr. Maudsley says, "One child may have it and another be free from it. It is a very rare thing for all the children of an insane parent to become insane; indeed, it seems sometimes as if the child which falls a victim drains off the taint for that generation, like a sort of scape-goat sent out into the wilderness, so that the other children escape. Nay, more, it sometimes happens that one child, aided by propitious surroundings, collects, concentrates, and develops into some form of genius the erratic forces which carry another child, not so favoured by its circumstances, into the vagaries of insanity. In like manner, it is not by any means certain that all the children of a phthisical parent will have phthisis. And, as regards epilepsy, although it runs in families in a

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<sup>1</sup> Dr. Maudsley.

very striking way, only one person perhaps in a generation is struck by it. . . . In all these cases, however, it is proper to take due account of the before-mentioned fact, that a disease-tendency which is latent or dormant at one period of life, or throughout the whole life of the individual, may undergo actual development at a particular physiological epoch, or an occasion of a great bodily crisis from some other cause (almost at the same time in twins, sometimes); and that a tendency which is latent or dormant in one generation may show itself actively in the next generation. Herein we recognise the pathological parallel of the physiological dormancy of qualities which was previously taken notice of; disease-tendencies, like parental characters of mind and body, are held in check or actually neutralised."

In approaching the consideration of those diseases in which heredity is an especial factor, I purpose to allude briefly to those diseases frequently occurring during uterine existence, in the brief first stage of life of the unborn; and, in the first place, it may be mentioned that some writers make a distinction between what they term *innate* diseases and those which are hereditary. The former may be defined as those diseases with which neither of the parents were affected, but were acquired by the foetus during its stay in the uterus, in consequence of outward noxious influences which operated upon it through the mother, without creating in her a disease similar to that which manifests itself in the child after its birth. These influences may be of a mechanical nature, such as pressure, a thrust upon the pregnant uterus, or of a dynamic or psychical kind. One or other of such influences, as also bad *regimen* of the mother during pregnancy, is very likely the cause of the so-called anomalies in the first formation,

and of many others, which are founded upon an irregular, perverted, or immoderately operating process of formation ; also of all those anomalies which are commonly considered as the consequences of the reception of a fright during pregnancy, and which cannot entirely be denied ; lastly, of all those different maladies which more recent authors have discovered in the foetus, and with which the mother herself was not affected.<sup>1</sup> As we have already seen, the individuality of every human being has its origin within the womb of his mother, for here are enshrined not only the mysteries of heredity, but also of that most potent factor of individuality—variability, to which every atom of humanity is subject. The phenomena of intra-uterine morbid variability are almost as numerous as those transmitted by heredity, and, curiously enough, many of them may be present, whilst the mother may remain entirely unaffected. Foremost amongst these individual morbid modifications in the unborn may be mentioned those dependent upon a perversion of the nutritive processes, which may partake of the character of hypertrophy or atrophy, and which may be general or local. Phenomena of an inflammatory type may also occur—the inflammation affecting the skin, the respiratory and intestinal mucous membrane, also that of the eye-ball ; the serous membranes likewise may undergo the inflammatory process, resulting, according to its situation, in arachnitis, pericarditis, pleuritis, or peritonitis ; whilst the organic structure of the lungs, kidneys, and thymus gland will sometimes be found to have undergone inflammation.

Morbid phenomena, of the nature of effusions or exudations are also frequently met with during uterine existence,

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<sup>1</sup> Steinau.

and may consist of blood or of serum. Sanguinary effusions have been found on the brain, in the lungs, and also in the pleural cavity, whilst serous effusion has been observed "between the membranes of the brain, into the ventricles, into the spinal canal, into the peritoneal cavity, into the cellular tissue beneath the skin, into the pelvis of the kidney, and into the pericardium."<sup>1</sup> Communicable diseases, also, such as syphilis (in its gravest forms), small-pox, measles, and scarlatina, have frequently been observed during the uterine existence of children; whilst, curiously enough, in many instances, the unborn children have suffered severely, although the mothers have been unaffected. In like manner, new growths, both simple and malignant, have become developed in unborn children when the parents have shown no trace of them. Moreover, the organs of children have been found, during uterine life, deeply involved by tubercular deposit; hydatid cysts have been found in the kidney, ascarides in the rectum, and stone in the bladder. The foetal heart has been discovered with its valves diseased; arterial dilatation has been observed, whilst limbs have been detected fractured, and joints dislocated or ankylosed. Besides these active forms of disease, the unborn are also subject to the whole series of malformations, embracing the absence or over-development of fingers or toes, webbed fingers, club-foot, strabismus, abnormal growths of hair, skin marks, etc.; also to arrests of development in the eye, hand, leg, heart, ear, or brain, and in those parts where a junction of medial structures is required, and is not perfected, as in cleft-palate, hare-lip, and spina bifida. Cyanosis, a malformation, owing to the opening that exists in the unborn

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<sup>1</sup> Dr. B. W. Richardson.

between the right and left sides of the heart, in the auricles, (and which should commence to close so soon as the child commences to respire), remaining open, is a condition sometimes, if not frequently observed.<sup>1</sup>

Such are but a few of the intra-uterine factors of individuality, from which it will be seen that every unborn child may have its health in after-life more or less influenced by agencies to which it is subjected within the womb of its mother, independently of heredity, and that natural variability which interacts with hereditary predisposition. So refined, indeed, are the influences thus exerted over the unborn, whilst in the maternal womb, that every abnormal throb of her heart—every abnormal vibration of her nervous system, is participated in by her unborn child, whether harmfully or favourably, and may leave impressions to which it may be subject during the entire period of its existence. And thus we see that the differentiation of individuals depends, not only on heredity and co-existing variability, but may receive independent impulses during uterine existence from agencies external to, and beyond the sphere of both. These being in no proper sense hereditary (although contributing to the individuality of the children), I shall not now further refer to them, but shall proceed, as briefly as possible, to consider those diseases in which heredity is not only a potent, but an essential element.

At the outset I may ask why is it that no two cases are exactly alike in any disease? And I, unhesitatingly, reply, owing to variability in the original inherited strength, or the acquired weakness of different organs and tissues. This question and answer really contain my argument, as in a

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<sup>1</sup> *Ibid.*

nutshell, for I have already proved, over and over again, that owing to heredity, natural variability, and the acquired modifications wrought by external circumstances, every individual differs from every other, not only physically, but also mentally and morally, and that in every element of his individuality. It is not, therefore, a fact that diseases—even those of an acute or exanthematous form—differ, or vary in their intensity beyond certain narrow limits, but that the real difference or variation is in the individuals affected, and the difference or variation extends not only to the ultimate elements of his physiological and psychological life—to bone, muscle, artery, vein, lymphatics, nerves, blood, plasma, and organs, but also to the constitutional vigour or feebleness—the natural power of endurance or intolerance—in a word to the vital stamina and energy, which he can summon to resist and overcome morbid processes when they assail him. Disease, is, indeed, the lot of humanity ; but every human unit differs essentially in his inherent and acquired power of resisting and controlling it. Who that has ever attended a family suffering from typhoid, scarlet fever, diphtheria, small-pox, measles, or whooping cough, has not witnessed the protean differences manifested in the several individuals composing it, as to symptoms, intensity, complications, sequelæ, and convalescence ? There is the disease of a known character and quality, but how different are its effects in the several members of the same family ! Can anyone say that the disease is different in each, or that the intensity of the symptoms in some of them is dependent upon a corresponding intensity of the virus ? Assuredly not ; the real, rational, and only explanation of its different manifestations must be sought and will be found in the inherited and acquired constitutional differences in the

individuals affected. These differences, so marked even amongst the children of the same parents, are naturally more obvious amongst those having no kinship, as in the case of unrelated individuals attacked by any of the diseases named, or by erysipelas, pleurisy, pneumonia, acute rheumatism, bronchitis, influenza, or any other acute or chronic disease ; we all recognise the differences every day of our lives, but how comparatively few of the rank and file of the profession regard them in their true light, and as dependent upon the differences existing between man and man, in consequence of the action and interaction of hereditary and acquired influences. If we regard diseases as so many entities of which we may all partake in different quantities, and not as particular conditions—new phases of the vital manifestations of the living body, whether of the nature of functional derangements, or organic or textural degeneracy—and which owe the differences of their symptoms, development, intensity, and modes of termination to the inherited and acquired constitutional differences existing between man and man, we shall not only be following wrong principles in practice, but prove unworthy of the trust committed to our care—the health and well-being of our fellow men.

It must not, however, be understood or supposed that I am anxious to try to prove that all diseases are alike hereditary ; but it does seem to me but a natural sequence, if we admit that, as I have indicated, every individual is subject to heredity in his physical, mental, and moral constitution, and to such an extent in his physical organisation that the minutest structure of his every organ and tissue, is characterised by it ; that the life-history of his parents' organs and tissues will be re-enacted, to some extent, at least, in his own ; and that when they have developed

organic or tissue derangement or degeneracy of any kind, he too will at least have inherited a predisposition to the same. This I think may be accepted as a broad statement of a general truth—the truthfulness of which is not assailed even when we consider the effect of such modifying factors as individual varieties of age, sex, and circumstances. The constitutional weakness, whether local or general, or the morbific predisposition transmitted by the parents may lie dormant in one generation, but only to appear in the next; and the only exception I know to the inheritance by the children of the morbid weaknesses and predispositions of their parents' organs and tissues, is to be found in cases where strains of weakness or disease in one parent are neutralised by the excessive vigour and robustness of the other. The laws of Nature are inexorable, and must be obeyed; yet conservative as she is in all her operations, she preserves the characteristics of the race and family by differentiating, within certain definite limits the individuals composing each, so that notwithstanding this individual differentiation, the race and family are perpetuated by heredity, and thus in a general, as in a particular sense, children resemble their parents, organically and dynamically, in their constitutions, functions, and every attribute.

Whilst admitting that we are as yet unacquainted with all the phenomena of disease that are transmitted by heredity, those maladies or general morbid conditions generally considered to be, and admitted as hereditary, may be tabulated as follows:—

(1) Blood diseases—viz. ...	{	Gout, rheumatism, diabetes, scrofula, tuberculosis, cancer, rickets, and syphilis.
(2) Nervous diseases .....		Epilepsy, chorea, insanity, hypochondriasis, neuralgia, apoplexy, paralysis.

(3) Physical deformities and deficiencies of special senses ..... } e.g., Blindness, deafness, etc.

(4) Early degenerations :— local or general ..... } Degeneration of vessels : fatty changes in organs, loss of elasticity in the skin. Premature greyness or baldness, loss of teeth, and other signs of decay.

(5) Some skin diseases, especially lepra and psoriasis.

(6) Emphysema and asthma.

(7) Gravel and urinary calculus.

(8) Haemorrhoids.

(9) Cretinism and albinism.

(10) Hernia.

(11) Icterus.

(12) Dropsy.

Hippocrates seems to have believed that almost all diseases can become hereditary, judging from the following quotation :—“ *Ex pituitoso pituitosus, ex bilioso biliosus gignitur, ut ex tabido tabidus, et ex lienososo lienosus,* ” etc. This opinion was evidently adopted by the majority of early physicians, and many even considered all fevers and inflammations as hereditary. Day by day we are learning that the hereditary proclivities of disease extend much further than any list now usually accepted, and that a new line for observation is thus indicated, which, industriously followed out, promises to yield the most important results. Dr. B. W. Richardson says: “ The further my own investigations extend—of the present, from experience and experiment : of the past, from historical reading—the stronger is the impression made upon my mind that the majority of the phenomena of disease have a certain hereditariness of character. For instance, that phenomenon which we call intermittent action of the heart, I have found to be distinctly hereditary. I have seen a child who exhibited it at the moment of birth, and to whom it was traceable through two

generations. The phenomenon in this case, nervous in character, is induced purely by mental shocks acting definitely, but in so refined a manner, on the heart, that we as yet know nothing of the physical change that is developed in the nervous matter. Again, I have known families in whom the tendency to some forms of communicable disease has been markedly apparent, and I have known instances of the reverse. Thus I have seen hereditary proclivity to scarlet fever and to diphtheria. I have also seen, in respect to one of these diseases (scarlet fever) hereditary opposition to it, if the term be allowable."

There can at least be no doubt that peculiarities of formation, and the tendency to particular affections, are transmitted in families from one generation to another; so that in one family will be recognised a peculiar form of the head, predisposing to inflammation of the brain, madness, epilepsy, paralysis, apoplexy, etc.; in a second family may be found a remarkable formation of the chest, leading to consumption; in a third family may be found a peculiarity of structure, predisposing to disorders and diseases of the heart; in a fourth an innate tendency to derangement or disease of the stomach, liver, and bowels; and in a fifth a predisposition to diseases of the skin; whilst in large families it may be found that some of the members have been prone to affections of certain organs, from generation to generation. These hereditary physical peculiarities are sometimes connected with peculiar conditions of the nervous system, but more frequently of the capillary portion of the circulatory system.

Discarding all accepted lists of hereditary diseases as such, I now propose to pass in rapid review the principal diseases of the human body, in connection with the organic

systems of which it consists, for the purpose of observing how far, or to what extent, they are subject to the influence of heredity, and how far this influence bears upon individuality as affecting disease. First, with regard to

*Diseases of the Circulatory System.*—Are these, or any of them, subject to heredity? Before this question is answered, it should be carefully borne in mind that the whole subject of disease tendencies and immunities in connection with heredity has been before the public and the profession for comparatively few years, and if I were to sum up our present knowledge of the heredity of these diseases, and reply in the negative, I fear my answer would savour more of ignorance than of scientific exactitude; for to say that things *are not*, when they *may be*, is surely presumptive of self-contented ignorance, and in direct opposition to the spirit of scientific inquiry and progress. Thus while circumstances may compel us to confess our ignorance, science is ever beckoning us on, and promising us increased knowledge and deeper lore if we only follow her aright. Synthetically we find man's physical, mental, and moral nature not only subject to, but to a great extent dependent upon heredity, and analytically we find all his organs and tissues subject to the same influence; and if such is the case in health, why should it not be so in disease—since diseases are simply new phases of the vital manifestations, partaking of the character of either functional derangement, or organic or textural degeneracy? And if so in some diseases, as it undoubtedly is, why not in all, as they are merely deranged functions, or organic or textural degenerations of organs or tissues which are unquestionably inherited? It is admitted that man, in all his parts and functions, is the result of heredity, with the exception of the

modifications effected by external circumstances ; nay, more, his constitutional vigour or weakness is, originally, due to the same cause ; also that he bears within him certain morbid tendencies which have been transmitted to him. Is it not therefore evident that the morbid conditions which afflict him must be due either to nature working within him, or circumstances working upon him from without ? And if it is conceded that his physical nature and parts are originally the result of heredity—that his constitutional vigour or power of resistance is originally due to the same cause, and that circumstances may develop inherent weakness of tissue or organ, I ask for nothing more, only that if certain tissues or organs in the body are predisposed to disease in consequence of heredity, it should be admitted that all may be, and probably are ; and if such be the case in brain and lung, why not also in heart, artery, and vein ?

Coming more closely to consider the diseases and anomalies of the circulatory system, I may ask, if it is admitted, as it is, that the quality of a man's bones, muscles, and organs is undoubtedly inherited, why should the heart-muscle and the blood-vessels be excepted ? And if it is proved, as it is, that certain inherent weaknesses of certain organs and tissues manifest a predisposition which circumstances may develop into disease, why should the heart and blood-vessels be exempt from inherent weaknesses of structure, which may in like manner predispose them to disease ? Without following this argument further, there can at least be no doubt that physiological functions are modified by anatomical structure in health as in disease, and thus the physiological functions of the circulatory system will be more or less modified by the structure of the heart, arteries, and veins, whether hereditary or acquired,

in any individual. For the present I do not consider it necessary to refer to congenital diseases of the heart, such as abnormal positions, congenital narrowness and closure of the ostia of the right side, stenosis and atresia of the pulmonary artery, with closure of the septum, stenosis of the right conus arteriosus, with an opening in the inter-ventricular septum, simple stenosis and atresia of the pulmonary artery with an opening in the ventricular septum, etc., my object being to demonstrate, not that certain diseases of the heart are congenital, but that, owing to heredity, variability, and accessory circumstances, the organs, vessels, and tissues of every human subject are so variously differentiated by individuality, that they are as variously predisposed to morbid influences, whether of the nature of adynamia, functional derangement, or structural degeneration. Temperament, idiosyncrasy, and diathesis are more or less involved in every question concerning the comparative health of individuals, but we must dig down deeper into the origin of constitutions if we are anxious to account for differentiation, which is as universal as humanity itself; and thus we find in the strongest and healthiest, as well as in the weak and invalidish, that in certain organs, vessels, or tissues, there is a predisposition to certain functional or structural alterations, which render their subjects, in varying degrees, liable to morbid influences, referable either to atony or adynamia, impaired functional activity, or structural degeneration. From this view let me now briefly inquire as to how individuality of tissue predisposes to diseases of the heart and circulatory system in general. Weakness, like the term disease, is only a comparative term, and, like the latter, it admits of infinite gradations or degrees. Inherent weakness of the circu-

latory system is the parent of many evils, and may evidence itself in many ways. The hollow, propelling muscle—the heart itself—may inherently lack the necessary vigour and tone indispensable for the normal discharge of its functions, the coats of the arteries and veins may likewise be inherently deficient in tonicity, and the blood itself may be deficient in quality and quantity. How protean are the effects of such causes, and how infinite are the degrees in which individuals may be affected by them ! And yet in proportion to the degree of cardiac or vascular inherited weakness, and in proportion to the quality and quantity of the circulatory fluid, will the individuals so affected be subject to the functional derangement or textural degenerations to which these inherent deficiencies predispose. Syncope, palpitation, intermittent action of the heart, angina pectoris, neuralgia cordis, cardiac spasm, oedema, chilblains, and the whole range of affections involving the complexion, from sthenic plethora to asthenic anaemia, are but a few of the morbid conditions resulting from functional derangement of the heart and its vessels, or of the vascular supply ; and to these may be added the various affections originating from vaso-motor and vaso-inhibitory derangement of arteries, and from thickened, weakened, contracted, or dilated vessels generally.

Roughly estimating the causes of diseases of the heart and the general circulatory system, they may be said to consist in inflammation—acute or chronic—hypertrophy, atrophy, dilatation—of such forms of structural degeneration as the fatty, calcareous, and amyloid, and of neoplasma, such as the carcinomatous, tubercular, syphilitic, and parasitic. Are all individuals equally subject to these, and if not, why not ? Simply because the cardiac and vascular tissues of many individuals are insusceptible, whilst others are, more

or less, particularly susceptible ; and in other cases the circumstances of their life-history have either developed inherited predispositions, or originated them *de novo*, to be passed on to future generations. Let us take, as an example of the inflammatory causes, acute diphtheritic or subacute verrucous endocarditis. What are the facts known as to their etiology ? Simply that one or both are usually associated with rheumatic arthritis, childbirth, or pregnancy, and occasionally with the acute exanthematous diseases. How many thousands of such conditions occur without the slightest implication of the endocardium at all ? And why should pericarditis be far more frequently associated with the gonorrhœal form of rheumatism than the endocardial form of inflammation ? Why, also, with regard to prognosis in the chronic and sclerotic form, are as many individual peculiarities produced by the diseases of the different valves as there are individuals affected ? Is the disease itself different in every individual ? Assuredly not ; but the real reason is that while the individuality of tissue in some predisposes them to such affections, in the majority of others it renders them insusceptible. So also with regard to degenerative changes in the cardiac or vascular tissues, whether fatty, calcareous, amyloid, tubercular, or syphilitic. We shall in every case find the result originating either in hereditary or acquired predisposition, or in both combined, and in every case the proportionate action of these factors is as different as are its results in different individuals. For hundreds who have suffered from heart affections of various kinds, and in different degrees, there are thousands and thousands who, during long lives, have neither experienced inconvenience nor derangement of any kind in connection with their circulatory system, and this exemption has been entirely owing to the

fact that neither their ancestors or parents, nor the circumstances of their own lives, have tended to produce or develop such conditions. This is a fact which, though recognised, is far too often lost sight of in diagnosing the actual condition of patients, as the knowledge thus gained of their individuality as exemplified by their predispositions, vital energy and endurance, so far as they can be estimated, is of far greater importance than any mere physical diagnosis, however exact, for whilst the latter, as Dr. Milner Fothergill says, may be a mere series of barren facts, the former mode is pregnant with potential hypotheses. Whilst it is obvious that these hereditary predispositions to particular diseases or morbid conditions cannot be quite neutralised or removed by medical art, yet if we also know, and can, by any means, obviate, the immediate agents which are the causes of these diseases, we may often do much towards their ultimate prevention.<sup>1</sup>

Are cardiac or vascular diseases heritable as such? I think I may safely reply in the affirmative: at least there can be no doubt that the organic or textural peculiarities which predispose to them are unquestionably transmitted from parents to their child or children. As I have already said, however, the entire subject is so comparatively new, and this particular question has received so comparatively little detailed attention, that the facts in support of an affirmative reply are not so numerous as they might otherwise have been. There is at least one case recorded by Lancissius, who says that he saw an enlargement of the right heart in a man whose father, grandfather, and great-grandfather were all known to have had the same abnormal structure of this organ. My friend, Dr. Ernest Sansom,

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<sup>1</sup> Dr. G. H. Barlow.

has also informed me of a case of a young man, in whom enuresis was complicated with aortic valvular mischief, which he had undoubtedly inherited from his father, who suffered from precisely the same complication! <sup>1</sup> I have myself witnessed cases in which intermittent action of the heart had been transmitted through several generations—also others of epistaxis, and abnormal distribution of the radial artery, which had been similarly transmitted. The almost specific hereditariness of hæmophilia has already been referred to, and it is an acknowledged fact that varicose conditions of the veins are so hereditary, that the predisposition has been regarded as forming a diathesis. Nothnagel, in estimating the etiology of cerebral hyperæmia, includes heredity as one of the factors of its production; at least, he admits the hereditariness of the apoplectic habit, and what he terms “plethora universalis,” of which cerebral hyperæmia is only a symptom. There can be little doubt, also, that the degenerative vascular changes generally associated with senility, whether of the nature of miliary aneurisms (Bouchard), or fatty, or atheromatous deposits, and which Dr. Chepmell has graphically described as “rotten vessels,” are very frequently if not invariably transmitted; at any rate, it must be admitted that the apoplectic habit, and consequently apoplexy, characterises certain families for generation after generation, and it is surely fair to deduce from these facts that a strong tendency to such vascular changes is assuredly inherited. What I am especially anxious to enforce is, that however potent circumstances may be in the development of disease, there is invariably a pre-existing disposition in every individual, which is as personal as his features or character, and which in every case will give a certain bias or tendency to the

<sup>1</sup> The distinguished Arnold family affords several examples.

morbid processes by which he may be assailed during his existence ; and the practical outcome of the due recognition of this fact will be that every patient will cease to be regarded as a mere animated machine like each of his fellows, and be appreciated as a man, in his microcosm, and as differing not only in form and feature from every other man, but also in temperament and diathesis, and in everything that concerns his predisposition towards morbid processes. Portal has justly observed, that in the treatment of patients whose ancestors are known to have died of some interior organic defect, we always ought to presume the possibility of the existence of a similar defect ; and, if the diagnosis be doubtful, we should, by a strict investigation, endeavour to find out whether our apprehension be well-founded or not. How all-important therefore is an intimate knowledge of the life-history of every individual, before we can diagnose his real condition, and treat him accordingly.

*Diseases of the Nervous System.* Not one alone, but several volumes might be written in discussing the diseases of the nervous system as affected by individuality. In the few pages at my disposal, I hope, however, to make it clear that owing to heredity, and natural or acquired variability they are all more or less subject to its influence. Indeed, so fully is this recognised that it has been alleged that the mysteries of hereditary transmission are pent up in the nervous system, and that the hereditary phenomena of disease are due to modifications in nervous matter. But how these modifications "pass from the parent to the offspring, and that, too, by paternal as well as by maternal line, is simple mystery, on which science merely speaks as yet to tell us that the fact must be accepted."<sup>1</sup> In the

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<sup>1</sup> Dr. B. W. Richardson.

course of the foregoing pages I have endeavoured to prove that the brain and nervous system are anatomically, physiologically, and psychologically transmitted by heredity; in other words that, organically and dynamically, the structure, functions, and powers of the human brain and nervous system are hereditarily transmitted from parents to their children. Of this fact there can be little or no doubt; but I have now to consider whether this statement is true in a pathological sense, whether in fact the scientific accuracy of the first statement does not involve an affirmative reply to the question: Are the derangements and diseases of the brain and nervous system subject, in like manner, to the law of heredity? In attempting to answer this question I propose, in the first place, to refer in a few words to those derangements or diseases of the brain grouped under the term morbid psychological heredity, and including Hallucination, Monomania, Suicide, Mania, Dementia, and Idiocy, and assume that there is no form of mental disease independent of an organic cause, for "since the direct cause of insanity is some morbid affection of the nervous system, and as every part of the organism is transmissible, clearly the heredity of mental affections is the rule."<sup>1</sup>

Esquirol observes, that, of all diseases, insanity is the most hereditary, and reliable statistics prove that it is so to the extent of from thirty-five to fifty per cent. All the forms and varieties of insanity are unquestionably transmissible by heredity, and nothing could be easier than to supply facts and cases in illustration and defence of this statement, but I shall content myself by quoting the following from the graceful pen of Dr. Maudsley concerning the hereditariness of suicide. He says:—"It is, indeed, striking and startling

<sup>1</sup> Ribot.

to observe how strong the suicidal bent is apt to be in those who have inherited it, and how seemingly trivial a cause will stir it into action. Persons afflicted by it will sometimes put an end to themselves on the occasion of a petty contrariety, or when they are a little out of sorts, and with almost as little concern as if they were only taking a short journey. Public feeling is much shocked, as if something very unnatural had happened, when a child of eight or nine years of age commits suicide, and is prone to rush to the hasty conclusion that so fearful an act would never have been done by so young a child unless it had been subjected to very cruel treatment. The real truth commonly is that the act is done for a cause that seems utterly inadequate ; perhaps because his master inflicted a slight punishment, or because his father scolded him, or because his mother refused to let him go to a school-treat. But if the child's family history be inquired into, it will usually be found that a line of suicide, or of melancholic depression with suicidal tendency, runs through it. So it comes to pass that a slight cause of vexation is sufficient to strike and make vibrate the fundamental life-sick note of its nature." Many examples might readily be given in support of these facts, and many more in connection with the heredity of hallucination, monomania, mania, dementia, and idiocy, but I can now only refer the reader to the works of Brierre de Boismont, Esquirol, Moreau, Maudsley, Trélat, and other writers on the subject, in which will be found innumerable instances of the heredity of every known form of insanity.

I must now consider, as briefly as possible, those very interesting phenomena denominated *metamorphoses* or *transformations* in *transmission*, which occur not only between generation and generation, but frequently also in the same

individual. These have been regarded as exceptions to the law of heredity, inasmuch as like in these cases can scarcely be said to produce like, but, as Ribot says, "We are anxious always to keep in view the important truth that there is never a total exception to heredity—the exceptions to it never going beyond the individual characteristics ;" so that we may regard these metamorphoses in transmission not so much as exceptions to the law of heredity—not so much as differences in kind as differences in degree, characterising certain individuals in consequence of the law of variability. To make plain what is meant by these metamorphoses in transmission, I may state that nervous affections are often so transformed. Those parents who have suffered from convulsions may have the predisposition inherited from them by their children changed into hysteria or epilepsy. A case is recorded where "hyperesthesia in the father branched out in the grandchildren into the various forms of monomania, mania, hypochondria, hysteria, epilepsy, convulsions, spasms," in fact nothing is commoner than "to see simple insanity become suicidal mania, or suicidal mania become simple insanity, alcoholism, or hypochondria." It would be very easy to give numerous examples of these metamorphoses taken from pathology and history, but for a detailed account of these most interesting phenomena I must refer the reader to the *Psychologie Morbide* of Dr. Moreau, of Tours, from which I have already quoted. He will there find that "the hypomania of parents may become in their children a tendency to suicide, insanity becomes convulsions or epilepsy, scrofula is replaced by rickets, and *vice versa*." As Ribot continues : "Fixed ideas in the progenitors may become in the descendants melancholy, taste for meditation, aptitude for the exact sciences, energy of will,

etc. ; the mania of progenitors may be changed in the descendants into aptitude for the arts, liveliness of imagination, quickness of mind, inconstancy in design, sudden and variable will." "Just as real insanity," says Moreau, of Tours, "may be hereditarily reproduced only under the form of eccentricity—may be transmitted from progenitors to descendants only in modified form, and in more or less mitigated character—so a state of simple eccentricity in the parents, a state which is no more than a peculiarity or a strangeness of character, may in the children be the origin of true insanity. Thus in these transformations of heredity we sometimes have the germ attaining its maximum intensity ; and, again, a maximum of activity may revert to the minimum." It should also be remembered that as in certain families, so also in certain individuals, two or more morbid predispositions may be found to co-exist ; thus it is not unusual to find such diseases as acute mania, epilepsy, and phthisis in children of one family, and the frequent appearance of cancer, as well as scrofula in families predisposed to insanity has also been observed ; in fact, Sir William Gull, in his address at the meeting of the British Medical Association, at Oxford, said that scrofulous children were not uncommonly the offspring of parents who had had cancer. So also in individuals it is no unfrequent occurrence to see phthisis followed by acute mania, religious mania succeeded by phthisis, scrofula followed by suicidal melancholia, psoriasis succeeded by acute mania—gout followed by insanity—gout succeeded by carbuncle, etc. That there is a strong hereditary element in all these cases cannot be denied, so that as has been observed, it behoves us to look out for indications of the existence in the same person of two or more morbid conditions or dispositions, such as may be derived from both parents or from several ancestors.

In seeking to account for these metamorphoses in transmission, occurring as they do, not only between generation and generation, but also frequently in the same individual, various physiologists have given as diverse opinions ; some regarding them simply as exceptions to the law of heredity ; others, as the result of a law of spontaneity, acting reciprocally with heredity ; others, again, as the result of both parents presenting the same characteristics, when heredity may acquire such power as to destroy itself. In following out my argument, however, I contend that these metamorphoses are simply the natural phenomena of the law of variability to which every individual is subject, and which is the fundamental element in his individuality. Heredity, we have seen, is the ideal, but unattainable law ; for Nature preserves the type or species not by simply reproducing the parents in the children in a monotonous succession, but by varying each individual within certain limits, so that no two individuals who have ever existed have been precisely alike. This fact, to which I have already alluded more than once, is to my mind a conclusive proof that these transformations in transmission are the result of the law of variability interacting with that of heredity ; for this variability of individuals extends to their whole nature—physiological and psychological ; and if so, why not also to those morbid predispositions which we include under the term pathological, since all are inherited in various degrees, varying with the individual. For example, let us suppose a man of nervous temperament marrying with a woman who has suffered from hysteria ; their offspring will to some extent resemble one or both physically, mentally, and morally ; but deeper down in the constitutions which they have inherited dwell potentialities capable of producing

epilepsy, alcoholism, hypochondriasis, mania in its every form—of ringing the changes upon the whole series of nervous disorders, and perpetuating them—unless neutralised by judicious inter-marriages, from generation to generation. No two individuals in any family or generation will be precisely alike any other physically, mentally, morally, or morbidly, but each will, *ceteris paribus*, have inherited in various degrees a predisposition to neuropathic conditions resulting from molecular morbific instability in the nervous systems of their parents or ancestors. So likewise, to what disastrous results may the union of a pair respectively gouty and scrofulous not lead? Gout, scrofula, tuberculosis in its protean forms, Bright's disease, heart diseases, haemophilia, cancer, rheumatism, chorea, apoplexy, and the whole host of dyspeptic troubles! These are but a few of the gross results, yet each individual involved will differ in the quantity and quality of his morbid heritage from every other, and it is thus, and thus, and thus, that I think the so-called metamorphoses in transmission may be satisfactorily accounted for. To sum up: heredity is the law, but the co-existing and interacting law of variability necessitates the differentiation of individuals; and so I regard these transformations in transmission not so much as differences in kind as differences in degree of inheritance affecting certain individuals, and that these degrees may be of the nature of development or neutralisation, *i.e.*, either an increase or decrease of the primary heritage according to the circumstances. As to how these metamorphoses occur, science is as yet silent: we have only to deal with natural phenomena, and to interpret them as best we may. As Ribot says: "We cannot tell why a given mode of psychic activity is transformed in

process of transmission, nor why it assumes one form rather than another. Were the solution of the problem attainable, it would doubtless reveal some singular mysteries. . . . In truth, we can only ascertain facts; but this is quite enough, since the facts show by what concurrence of fortuitous circumstances and accidental causes nature produces diversity."

But to return to the consideration of heredity in connection with nervous diseases. It must be conceded that heredity predisposes mankind not only to such diseases as epilepsy and insanity, but to peculiarities in the mode in which man is affected by minor ailments. For example, how frequently do we recognise a predisposition to cephalalgia in those families whose inheritance seems to have especially influenced the nervous system; also to dyspeptic troubles, involving nausea, vomiting, and diarrhoea, and to the manifold affections usually regarded as disturbances in the vaso-motor system? Not only so, but it is a well-known fact that the members of certain families will live into old age, however they may have subjected themselves, or been subjected to pernicious influences during their lives; and notwithstanding their being thus handicapped in the struggle for existence, will contrast most favourably with those who apparently have lived simply, carefully, and well. In connection with hereditary predisposition to diseases of the nervous system, Dr. W. B. Carpenter says: "The fact seems to be that the nervous system is so peculiarly liable to be shaped and modified by the mode in which it is habitually called into exercise, that it takes on a particular abnormal form of activity far more readily than any other organ; and thus, when a special form of malnutrition has once established itself, this may be transmitted to the offspring without the prolonged action of

its special factor through many successive generations." That acquired predispositions tend to produce themselves in the offspring is proved by the fact, evidenced by the same authority, that the effect of habitual alcoholic excess not only produces a tendency to insanity in the subject of it, but also engenders in the offspring (especially when both parents are drunkards) a disordered state of brain-nutrition, which may express itself in idiocy, epilepsy, alcoholic craving, mental instability, weakness of will, incontrollable hysteria, and the like, as well as insanity. And the same may be said of abnormal moral habits, which, when they have fixed themselves in the cerebral organism, tend to reproduce themselves in succeeding generations, as we see in hereditary kleptomania.

Dr. Bastian says: "It is now a well-established fact that persons who are endowed with a neurotic habit of body, very frequently transmit a similar tendency to their children. It is not a tendency to any one particular disease, but a vulnerability of the nervous system as a whole which is transmitted, so that under the influence of even a comparatively slight strain, this weakness may manifest itself in one or other of various ways. It may reveal itself by mere general nervousness or tremors, by attacks of chorea, by epilepsy, or by one or other of the forms of insanity." This quotation refers to the now well-established neuropathic predisposition, which may be either inherited or acquired, and which is a factor of prime importance in the etiology of such neuroses as the psychoses, chorea, epilepsy, hysteria, hypochondriasis, etc. By this term we understand a pathological constitution affecting the functional activity of the nervous system (Griesinger), in consequence of which those subject to its influence exhibit throughout their lives the utmost variety of symp-

toms in connection with pathological processes, whether sensory, motor, or psychical. Science has as yet nothing to say as to the real nature of this peculiar anomaly ; and however some may seek to account for it by the aid of "delicate trophic disturbances," or "modifications of molecular arrangement"—hypotheses so vague and useless as to explain nothing—we can only console ourselves with the fact that such constitutional neuropathies really exist, and that future researches will, it is to be hoped, throw some light upon a question which is at present inscrutable.<sup>1</sup> Professor Erb, in referring to the hereditary neuropathic predisposition, describes it as "that unfortunate condition which forms the inheritance of so many families, in which the most diverse forms of neurosis are, so to speak, innate, and propagate themselves from one generation to another, sometimes affecting chiefly the psychical, sometimes the sensory, and sometimes the motor and vaso-motor regions of the nervous system. To it many forms of neuralgia owe their origin. Anstie, who has paid particular attention to this neuropathic hereditary predisposition, attributes to it not only a predisposition to psychoses, epilepsy, chorea, hysteria, paralysis, etc., but also to phthisis, and states that in eighty-three cases of neuralgia investigated with regard to this point, he found there were seventy-one in which such a family predisposition existed, and of these, fifty-three cases occurred in neuropathic, and eighteen in phthisical families. In such cases the coincidence of neuralgia with other neuroses, or its alternation with epilepsy, various psychoses, migraine, etc., is not unfrequently observed. This hereditary origin of neuralgia is of course most obvious in the not unfrequent cases where there is a direct hereditary transmission

<sup>1</sup> Ziemssen.

from the parents to the children, where the father or mother has suffered from neuralgia, and the child has likewise been subject to it." This condition, whilst necessarily associated, must not be confounded with the nervous temperament from which it differs materially: inasmuch as mere temperament involves in itself no morbific predisposition, whereas the former is essentially neuropathic, and signifies that every atom and molecule of the nervous system bears upon it the impress of a pathological condition which is inherited and indelible. It might indeed be regarded as a nervous diathesis, which it really is. There are also certain constitutions of mind which are not only peculiar in themselves, but which predispose to nervous affections, and are capable of being perpetuated by heredity. Thus in one family one may find but little irritability or sensibility prevailing, so that each member may be compared to a "lake sunk between two hills—the wind and the storm may pass over it and not ripple its surface. In another family one finds a high degree of irritability and sensibility prevailing, so that one of its members may be compared to a delicate tree planted on some mountain top—blown about by every breath of wind—bent before the slightest breeze, the rude blast tears it up by the roots, and it withers!"<sup>1</sup> Well, indeed, may we regard Man as the sublimest and most wonderful being in the universe, for in every element of his microcosm, each human being differs essentially from each other, and as in health, so likewise in disease !

Amongst those nervous diseases, a predisposition to which is undoubtedly inherited, I shall instance, in the first place, *hysteria*. So important is this predisposition as a cause of hysteria that it is capable of developing not only a tendency or liability to it, but also the complete evolution of

<sup>1</sup> Armstrong.

the disease itself; whilst the hysteria of parents or ancestors usually predisposes to hysteria in the children—thus denoting an inheritance of like tendencies, and especially in transmission from mother to daughter. Various other nervous affections, which have appeared in the ancestors, favour a disposition to hysteria in the descendants; just as it happens, on the other hand, that hysteria appears in one generation, and epilepsy, chorea, insanity in the next. Briquet has proved that more than a fourth of the female descendants of the hysterical suffer in their turn from hysteria; and Amann has recently stated that in 208 cases of hysteria he proved with certainty an hereditary tendency 165 times—that is in seventy-six per cent. All those phenomena which indicate the possession of a neuropathic predisposition have a decided influence upon the transmission of a tendency to hysteria: moreover, privation, insufficient nourishment, debility in the parents arising from senility; or chronic diseases, as phthisis, apparently favour the development of a tendency to hysteria in the children. The inherited tendency to hysteria may for a long time remain latent, until, in fact, some constitutional shock or epoch develops an outbreak of the disease. In other cases the transmitted predisposition may be strong and effective enough to develop it independently. It should, however, be remembered that in a few cases hysteria may result in a child from the mere fact of its imitating an hysterical parent. That weakly constitutions manifest a greater predisposition, must be conceded, just as acquired conditions of debility favour the development of the disease. Herein is probably to be found the connecting link in those cases in which debility of the parent induces hysteria in the descendants.<sup>1</sup>

<sup>1</sup> Jolly.—Ziemssen, vol. xiv.

*Epilepsy.*—The hereditariness of a predisposition to this affection is beyond all doubt, as is acknowledged by every authority who has written upon it. The predisposition itself may be transmitted directly from parent to child, or it may remain latent in a generation or two, and appear in the grandchild or great-grandchild; moreover, it may be traceable only in the collateral branches of the ancestry, as in hereditary maladies. Predisposition may also be connected with congenital formation, as is often evidenced in cases of chronic hydrocephalus, also in those in which there is a misshapen or unsymmetrical form of the head. Amongst other predisposing causes may be mentioned the scrofulous diathesis and idiosyncrasy; also the epochs of childhood and puberty, at which periods the nervous and muscular systems attain their maximum of sensibility and irritability, and the physical susceptibility is greatest. With regard to the influence of the scrofulous diathesis, Dr. Cheyne holds that epilepsy is as certain a manifestation of the strumous disposition as tubercular consumption, or psoas abscess; but it may be observed that the strumous diathesis, and a particular conformation of the head, are both very likely to descend from parents to their children.<sup>1</sup> In those cases of epilepsy which are hereditary, the affection is usually developed at an earlier age. In the great majority of cases epilepsy is developed between ten and twenty years of age, and especially at or about the period of puberty. According to Echeverria, the occurrence of the symptoms of hereditary epilepsy is before puberty; according to Reynolds, not later than the twentieth year. It may, therefore, be assumed that an individual with an hereditary predisposition, remaining healthy up to the twentieth year, will also escape epilepsy

after that time, so far as its development is excited by the hereditary tendency alone. Such individuals often suffer from eclampsia as early as during the first dentition, but afterwards again remain apparently healthy up to the outbreak of the epilepsy.<sup>1</sup> Although the father or mother of the patient may never have had an attack, either of the grandparents, or uncles or aunts may have been subject to it. *Zacutus Lusitanus* mentions the case of an epileptic man who had eight children and three grandchildren afflicted by the disease. *Stahl* and *Reininger* adduce instances of the whole of the members of a family being attacked by it at the period of puberty. *Boerhaave* remarks that, like several other hereditary maladies, it often passes over alternate generations, and he adduces an instance in which all the children of an epileptic father died of it. *Dr. Copland* says: "I had, in 1820, a brother and sister some time under my care, who inherited the disease from their father, and they had two other brothers and one sister also subject to it—in all five. The fits appeared in all of them about the period of puberty, and one of the brothers died about the age of forty from apoplexy, complicated with the seizure. *MM. Boucher* and *Casauvieilh* state, than in 110 patients, respecting whom they had made inquiry, 31 were hereditary cases; and *M. Esquirol* found, that in 321 cases of epileptic insanity, 105 were descended from either epileptic or insane parents."

Amongst those cases in which the disease is produced by factors of a kind not appreciable anatomically, which at times affect the nervous system alone, at others the whole organism, inherited predisposition or tendency occupies the first place, and is of prime importance. Seeing that all observers are agreed upon this fact, I need not further cite either statistics

<sup>1</sup> *Nothnagel*.

or instances in its defence, although in addition to those already quoted, I may be permitted to mention the experience of Echeverria, who, out of 306 patients under his own care, had observed 80 with an hereditary tendency. With regard to this hereditary tendency to epilepsy, we must be careful not to limit it too much in its signification, as, for example, in assuming that epilepsy only and strictly in the forbears is calculated as strictly to reproduce epilepsy in the children. This view cannot be upheld for a moment, as owing to those phenomena of the law of variability which I have already referred to, and which are denominated metamorphoses in transmission (by which also the differentiation of individuals is necessitated and secured) it by no means follows that the ancestral or parental form of affection is strictly inherited by, or transmitted to the children, but that whilst similar in kind, it may be very different in degree. As Professor Nothnagel, of Jena, says: "The children of those parents may become epileptic who have been mentally diseased, but who have never suffered from convulsive affections. The fact is, hereditary disposition must be taken in a far broader sense, and the proposition may be enunciated that any neurosis in the parents, whether it be of a lighter or more serious kind, may plant in the children the germ which may develop into epilepsy. This obtains not only in regard to hysteria, hypochondria, and catalepsy, but I have observed cases where—*e.g.*, the mother suffered for many years from pronounced migraine, and with this exception there was absolutely nothing else in the way of family tendency to be found, and yet a daughter was hysterical, and a son epileptic. From my experience, I am even inclined to ascribe to neuralgia of many years' standing in the parents, a capacity of producing epilepsy in the children. There are even not

wanting instances where, in connection with a mere 'nervousness' of the ancestors, epilepsy made its appearance in the descendants."

I have already stated that in hereditary epilepsy the first occurrence of its symptoms is, according to Reynolds, not later than the twentieth year; and to this I may now add that an individual who has inherited a predisposition to epilepsy may escape its development altogether if his general health remains satisfactory up to this period. This latter statement depends, of course, upon the assumption that the attack is produced entirely as the result of the inherited predisposition, and does not affect the occurrence of epileptic seizures from other causes. Although epilepsy may be caused by many factors, such as alcoholic and sexual excesses, prolonged mental strain, disturbances of nutrition, as produced by defective nourishment etc.; external injuries, etc., yet none of these are so effective in exciting "the central epileptic change" as hereditary predisposition. Why this inherited tendency should be so much more active during youth—from the seventh to the seventeenth year—we really cannot satisfactorily explain, notwithstanding the many theories which have been propounded to account for it: we can only at present accept the fact, and trust that time may throw some further light upon this interesting question in the future. With regard to prognosis, Reynolds maintains that those cases are least amenable to treatment in which the source of the disease is involved in the greatest obscurity.

*Chorea.*—As in hysteria, epilepsy, etc., there is a marked hereditary predisposition to chorea—*i.e.*, "an hereditary transmission of a special susceptibility to irritation—an impressionability of the nervous system"—generally associated with constitutional debility. Thus, as quoted by Von

Ziemssen:—Dr. Huntington, of Long Island, with his father and grandfather (also physicians) says he has observed entire families of choreic persons, in which the disease was propagated until once a generation had been overleapt, when the hereditary disposition in that family ceased. In these cases the chorea began between the twentieth and fortieth year of life; attacked men and women alike, and usually led to mental disease, often associated with suicidal tendencies, and finally to death. That chorea may be congenital—*i.e.*, transmitted hereditarily, admits of no doubt, although the occasions of such actual transmission may be regarded as comparatively rare. Fox has recorded a case in which the child, a male, was born six weeks before the period, and from the first hour of his life he suffered from violent choreic movements, which gradually developed into epilepsy in his third year; after which he had no further attacks, but his speaking and walking were defective up to this thirteenth year. Richter also mentions chorea as occurring congenitally in the case of two girls whose mothers had been frightened when far advanced in pregnancy. From their birth the children suffered with chronic spasms, which ceased during sleep, and eventually disappeared almost entirely.

That chorea is often mimetically contagious, is also a well-established fact: thus Leube saw two girls, of the ages of sixteen and seventeen, hysterically predisposed, who acquired chorea in consequence of intercourse with another girl, aged twelve, who had the disease. Bricheteau also mentions the following interesting case:—A girl was admitted into a ward in the Hôpital Necker where there were girls who were hysterical, and who had formerly been the subjects of chorea, and within six days eight other patients in the same ward were taken with chorea. The further spread of the disease

was arrested by isolating the chorea patients. The intensity of the symptoms varied greatly ; some of the attacks lasted for months. In connection with such contagious or imitative cases, the especial point to remember is that a *distinct predisposition* seems to be necessary to propagate the disease by imitation : otherwise the number of instances would be much greater than it is.<sup>1</sup>

In this connection I may now briefly refer to *alcoholism* ; the pernicious effects of alcoholic excesses on the nervous system being well known, and these are, according to all competent observers, markedly hereditary in many cases. In cases of inherited predisposition to chronic habitual drinking, it is not absolutely necessary that the parents or ancestors should have been drunkards, but that the family is characterised by that form of unstable nervous organisation which I have already alluded to as a neuropathic predisposition, and that the neurotic taint which manifests itself in other members in such affections as hysteria, epilepsy, and insanity, will be manifested in these cases by an intense, if not insuperable, craving for alcohol. At the same time it should be borne in mind that owing to the tendency which acquired predispositions have to reproduce themselves in the offspring, drunken parents may actually transmit this predisposition to their children, or if not, then such a state of disordered cerebral nutrition as may express itself in epilepsy, insanity, idiocy, hysteria, weakened will-power, or mental instability. Here again we see how the differentiation of individuals is maintained by pathological processes ; for, given a drunken parent or parents, their children will assuredly inherit such a neuropathic disposition, as in the case of one of them may manifest itself

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<sup>1</sup> Von Ziemssen.

in idiocy, in another as epilepsy or hysteria, in another in weakness of will, and in yet another or others in uncontrollable alcoholic craving; some may escape in their own persons, but only to hand down the heritage of their parents' shame to others and succeeding generations. Dr. Richardson has well said:—"The solemnest fact of all bearing upon the physical deteriorations, and upon the mental aberrations produced by alcohol, is that the mischief inflicted by it on man through his own act and deed cannot fail to be transmitted to those who descend from him, and who are thus irresponsibly afflicted. Amongst the many inscrutable designs of nature, none is more manifest than this, that physical vice, like physical feature and physical virtue, descends in line. But not one of the transmitted wrongs, physical or mental, is more certainly passed on to those yet unborn than the wrongs which are inflicted by alcohol. Many specific diseases engendered by it in the parent are too often stamped in the child; while the propensity to its use descends also, making the evil interest compound in its terrible totality." It is unnecessary for me to dilate upon the many acute and chronic diseases caused directly and indirectly by alcohol; but the point on which I would especially insist is that the protean pernicious effects of alcohol taken in excess do not, unfortunately, end with the miserable life of the poor drunkard, but are passed on to his irresponsible children as a legacy from violated nature—an indelible brand, an inherited curse—which may express itself in a distinct neuropathic predisposition capable of developing insanity, hysteria, epilepsy, impaired volition or mental instability, and of reproducing the primary vice in which it has originated. Of the real nature of this predisposition we know nothing, beyond the probability that the

nervous centres are somehow implicated in its production, but we must for the present be content to accept facts as we find them, and trust that further researches may be able to throw light upon a subject which is now obscure and mysterious.

Having now considered the hereditary element in insanity, hysteria and its allies, epilepsy, chorea, and alcoholism, I might readily refer also in detail to neuralgia, cephalalgia, migraine, tubercular meningitis, sanguineous apoplexy, locomotor ataxy, progressive muscular atrophy (Cruveilhier's paralysis), pseudo-hypertrophic muscular paralysis (Duchenne's paralysis), sclerosis, and other nervous diseases which are alike subject to heredity, but I think I have adduced sufficient evidence to support the principle for which I am contending—viz., that whether the nervous system contains the *fons et origo* of heredity or not, its diseases are markedly hereditary; furthermore that the pathological differentiation of individuals is manifested to an extraordinary degree by the transmission of nervous diseases, for, given a neuropathic predisposition in the parents, it is found capable of developing a tendency in the offspring not only to itself, but also to hysteria, epilepsy, chorea, insanity, neuralgia, and in fact to ring the changes on every known variety of nervous disorder or disease. Thus we see in every family, the members of which have inherited a neuropathic predisposition, that it may not only develop into various forms of nervous disease, but that each member has inherited *something* which the others have not, whilst some may only act as mediums for transmitting the predisposition to a future generation, and at the same time they themselves may show no evidence of its possession. The differentiation of individuals is absolutely necessitated physiologically and psychologically

by the interaction of heredity with the law of variability, and so it must be pathologically for the reason I have elsewhere stated—viz., all morbid action is but a modification or perversion of some natural or normal action or function ; and all the physical results constituting morbid structural alterations are mere perversions or modifications of natural or normal textures, or, at most, analogous textures fabricated from the same materials by like processes. Every living individual, therefore, differing as he does from every other physiologically and psychologically, must also differ from every other in his pathological tendencies ; and I believe that ignorance of this fact is the most fruitful source of false views both in pathology and in practice. As too much stress cannot be put upon my argument in this direction, I once more briefly summarise it here. By the law of heredity, all living beings tend to reproduce themselves in their offspring physically, mentally, and morbifically ; but owing to the law of variability which interacts with that of heredity in the case of every individual, the likeness is never perfect—the ideal law of heredity that like produces like is never attainable. We see this even in the case of twins, whose resemblance to each other, however striking, is still far from perfect. However much a child may resemble its parents—or one child another—essential differences will be found externally and internally, physically and mentally, and with regard to their pathological tendencies. As in health so also in disease: Nature preserves the type by varying the individual ; and as in health so also in disease, the individuality of every living man is necessitated and maintained by the law of variability. The phenomena of variability in health are seen in the physical and mental differentiation of every individual from every other, however closely allied ; the phenomena of

variability in disease are seen in the differences of individual constitutions, as to their mode of manifesting the effect of the same morbific cause, and their relative power to sustain it, and in the metamorphoses or transformation in transmission, to which I have recently alluded. The great principle for which I am contending is the due recognition of individuality in every case presented to us, remembering always that physical and mental differentiation necessitates the differentiation of pathological processes ; and that, co-operating with the great law of heredity which tends to produce like from like, is the equally potent, if subservient, law of variability, which necessitates our differentiation from each other physiologically, psychologically, and pathologically, and by means of which our individuality is developed and maintained.

*Diseases of the Respiratory Organs.*—In proceeding to consider the hereditary element in the diseases of the respiratory organs, I shall not content myself by merely stating that certain of these diseases are distinctly hereditary, but taking a broader view of them all, I contend that, for reasons insisted upon over and over again in the foregoing pages, there is a predisposition of tissue inherited by those who suffer from any of them, as, indeed, there is, and must be, in all morbid processes which are not distinctly acquired. As I have already stated the nature of these predispositions is unknown to us, but of the following fact there can be no doubt—viz., that physiologically, psychologically, and pathologically, also, the textural and functional peculiarities of ancestors and parents are handed down to their descendants by heredity in varying proportions, modifiable by variability and the influence of external circumstances. The law of heredity is inexorable,

affecting body and mind in health and disease, so that every record of disease in a parent's life-history is stamped indelibly on the tissues of his child. Let me not, however, be misunderstood; I do not mean that the diseases of the parents are handed down in every case as entities to their children, but that the textural or dynamical peculiarities of parents, whether inherited or acquired, will undoubtedly be reproduced, in varying proportions, and subject to certain modifications, in their children, as, at least, predispositions to the same. This is very mysterious; and although we cannot understand or explain the processes by which such effects are caused, we must, as the result of observation and experience, accept the fact that, as surely as a child resembles his parent or parents in his or their external configuration, so assuredly does the resemblance extend to his internal textures and organs, and even to a predisposition to the same morbid processes from which they may have suffered, and which he has inherited from them.

*Pulmonary Phthisis.*—Of the diseases of the respiratory organs none, perhaps, is more dire in its effects, or more unquestionably hereditary, than pulmonary phthisis or consumption, which has been known to exist contemporaneously with the sources of our historical information, and to which, according to Hirsch, probably two-sevenths of all deaths are now due. Without entering into a discussion of the various pathological theories which have been broached from time to time as to the real nature of tubercle, I shall content myself by observing that there is a correlation, however imperfectly understood, between the scrofulous and tubercular diatheses, and that while both are markedly hereditary, the tubercular diathesis is met

with only in the scrofulous. "How this inherited diathesis," says Ruehle,<sup>1</sup> "is produced, or what is its real nature, are questions beyond our present knowledge; but if the external form of the body, and mental qualities, can be transmitted in families through generations, why should this not be the case also with the conditions which produce a disposition to certain diseases? If in the former case we do not demand that the comparison be made only between children and their parents, but include also the grandchildren and nephews, why should we not observe the same rule in regard to the inheritability of disease? Why do we narrow the question to asking whether the father or the mother is known to have the same disease at the time of conception? Is not a disease often present before it can be recognised? May there not be a disposition sufficient to be transmitted, although it does not manifest itself as a recognisable disease until afterwards?" In answer to such questions as these, I unhesitatingly reply to each of them in the affirmative. For, in the first place, as heredity is a law of our being, and as the material, functional, and dynamical peculiarities of ancestors and parents are transmitted by them to their descendants, it assuredly follows that the conditions which produce a predisposition to any morbid process are also transmissible. We are too liable to narrow down the question of hereditary descent as if affecting only the qualities inherited by a child from his parents, whereas it is a matter affecting the evolution of the race. Every living individual has been dependent upon some other or others as far back as the history of man is recorded by the hand of time; for has not every unit of the human family originally sprung

from one source? and if we could each trace our pedigrees back into the ages when man first made his appearance upon earth, we should find them all converging in him the primal and earliest father of our race—whose brow first shone with the divineness of humanity. If heredity is a law of our being, it has been so since man first appeared on earth; let us see how this affects the question. Let us take the case of any living individual: he must have had a father and mother; these also must have had fathers and mothers; and these also; and so on back through the ages to the earliest parents of the human family. We may regard health and disease as coeval with human life; therefore the pedigree of disease is not to be regarded as of recent origin, or its sources traceable to recent influences, but rather to be found in the records of the earliest history of man, wherein we may read the “record of its long descent.” Throughout the ages, and amid the many altered conditions of the earth, man has been much the same as he now is, as far as his subjection to the laws of heredity and variability; the same in barbarism as in civilisation; the same with regard to his health and his diseases; it therefore follows that whilst the influences of heredity are strongest upon him, the more closely he is subjected to the influences of his more immediate ancestors, all the past may be said to slumber in him. We should not therefore regard hereditary descent as affecting only the transmission of the parents' peculiarities to their children, but also the transmission of qualities derivable from earlier, and even remote, ancestors. How necessary this is we can infer from the frequency with which latent or dormant peculiarities—traceable to some remote or collateral member of a family—develop themselves unexpectedly in some of his descendants; and thus it is that

every patient who comes before us is made up of such a mingling of temperaments, idiosyncrasies, and diatheses, as can only be appreciated, and that imperfectly, by even the keenest diagnosis ; and of inherited peculiarities of tissue, and function, and dynamism, which may be active or latent ; of potentialities or deficiencies which morbid processes can alone reveal.

But to return. Statistics are, and can only be, unreliable and valueless in regard to the percentage of inherited cases of phthisis, and we can only accept the concurrent testimony of every age, which is so strong that it cannot be doubted or rejected. Whole families have been exterminated by phthisis, and according to Hörlin, as stated by Hirsch, in the island of Marstrand, where only one person had died of consumption during seven years, there were five consumptives then living there, four of them sisters, whose mother had died from this disease. The inherited predisposition to consumption may reveal itself in different ways—sometimes in constitutional delicacy, sometimes in special local affections of the thorax or its organs—and these may or may not be observed at birth or during childhood, but are generally noticed at a later period, as, for example, at the time of puberty, when growth and development are more rapid. However we may subdivide the inheritability of phthisis we cannot but regard it as a factor of prime importance in the etiology of the disease. Although this predisposition is commoner perhaps among women than men, and its transmission more common through the mother than the father, yet where one parent only is affected fathers transmit more readily to sons, and mothers to daughters, than the converse. Dr. Pollock lays stress on the influence of hereditary predisposition in the acute forms of phthisis, and states that out

of 179 cases only 34 could positively declare absence of family taint. Dr. Theodore Williams says the principal effect of the predisposition is to be seen not in any peculiarity of the symptoms, but by the influence it exercises over the age of attack, which is much earlier in those predisposed than in others.

Regarding phthisis as a disease essentially belonging to those which are dependent upon an inherited predisposition, and as the concurrence of several conditions is usually necessary for the development of chronic diseases, we must differentiate between those conditions which are inherited and those which may be acquired. Of the former we must recognise a congenital defectiveness of resisting power, which although not synonymous with weakness, may be associated with it. This is generally manifested in the children of weakly parents, or of closely-related inter-marriages, or when there is a marked dissimilarity in the respective ages of the father or mother, or when repeated pregnancies have followed each other in rapid succession. "Usually in such persons one or several parts of the body are again and again the seat of disease, and form the *locus minoris resistentiæ*. If this be situated in the respiratory organs, frequent and long-continued catarrhs of the nose, larynx, and air-passages occur, and perhaps give rise ultimately to pulmonary diseases which develop into phthisis."<sup>1</sup> This condition is essentially transmissible, as is also scrofula, another of those conditions which usually concur in the production of chronic diseases.

There is a point of some importance to which I should have referred before, and which I may now be permitted to allude to, especially as it exercises a modifying effect upon the influence of heredity generally, and to a great extent

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<sup>1</sup> Ruehle, *Opus cit.*

affects the inheritance of disease—viz., that which has been denominated “the tendency to reversion from all variations of specific characters ;” for, as the preservation of the specific characters of the species essentially concerns the law of heredity, the determination of individual characters is manifested most in the law of variation : and thus, the inheritance of a disease-tendency, however probable, is not invariable, as disease-tendencies, like parental characters of mind and body, are either held in check or actually neutralised by one of the parents of the child being healthy, so that the constitutional disease of the other may be, in a manner diluted. “Phthisis,” says Dr. Maudsley, “ is a notorious instance, passing so directly from parent to child, as to entail the extinction of a family when it is not neutralised by favourable inter-breeding. For such neutralisation, not of phthisis only, but of other disease-tendencies, may undoubtedly be effected, although we have not at present any knowledge of the laws by which the good result is brought about ; the fact, however, is certain, and profoundly significant. The union of two individuals, one of whom has a marked disease-tendency of a particular kind, produces an organic constitution in which it is held in neutralisation or check, never showing itself in their children. It has become a disease-immunity for that generation. Did we know the exact nature of the neutralising process it would no doubt be possible, by suitable arrangements for subsequent breeding, to get rid entirely of the morbid tendency and to obtain a perfectly sound stock. Unfortunately we do not, and so are liable to find the neutralisation temporary, since it not unfrequently happens that the union of the offspring which is apparently free from the disease-tendency, because it is held in check, with a person who is also apparently free from it, produces an organic

nature in which it shows itself distinctly. It is somehow made a disease-aptitude again." Sir James Paget says: "Through such dilutions and such tendencies towards recovery of health in embryo-life, and in a less degree after birth, we may believe that many of the lesser constitutional diseases are derived; but of the rate of diminution in transmission, and of the possible changes of form associated with changes of intensity or quantity of disease, we know very little, if anything. And very little we know of the results of the transmission of more than one constitutional disease to the same offspring. We can often see plainly that the forms in which different persons display a constitutional disease appear very different from those seen in their parents. Thus, in a family of which one or both parents had typical gout, or tuberculosis, or scrofula, there may appear any number of the lesser forms of these diseases, or of the forms deviating furthest from the type. And yet a certain general similarity may appear in all the local manifestations of each constitutional disease thus variously transmitted. They may be unlike in structural appearance while affecting different structures, and yet they may be like in their time-work, or in the production of some characteristic morbid product, or in the influence which medicines or diets exercise on them. These things may prove the same constitutional origin in apparently very different local diseases." This long digression may, I trust, be excused, as I had omitted to refer particularly to those neutralisations or checks to inheritance which frequently result from favourable inter-marriages; but it will be seen that these neutralisations or checks—however they may be perpetuated in theory—are in the majority of instances nothing more than examples of *atavism*, and that the original disease-tendency is transmitted

to a generation by heredity, subject of course to the law of variability so far as individual characteristics are concerned.

To return, however, to the further consideration of the diseases of the respiratory system as subject to the influence of heredity, I may regard pulmonary phthisis as a typical constitutional disease occurring in persons of the scrofulous diathesis. When considering the diatheses I was careful to point out that their development, in the great majority of cases, required many generations in which to accomplish it, for they are in reality peculiarities of health amounting to morbid tendencies which have been accumulated and intensified in their long descent so that we can now recognise them as types of constitutions with which are generally associated certain well-known forms of disease. Of these diatheses which were termed universal, because they are not only as old as the race, but because every individual is more or less subject to their influence, are the *scrofulous* and the *catarrhal*; there is surely, therefore, no occasion to prove transmissibility! These may co-exist or be blent in varying proportions in different individuals, and it may be stated as an axiom that the more the scrofulous diathesis preponderates, the greater the danger of catarrhal attacks in an individual. Mr. Hutchinson has well defined scrofula as a permanent and heritable condition, favouring chronicity in all inflammatory processes, and directing them towards more or less specialised ends; and catarrh, as inflammatory congestion excited, in a reflex manner, through the influence of cold applied to the surface: therefore, whatever is the result of "catching cold" is catarrhal. He says: "The susceptibilities of the nervous system, however, in this direction differ, as we all know well, very greatly in different individuals. These differences are hereditary, and may

easily become the possessions of families or of race. Not only do individuals differ in the degree of reflex susceptibility, but they also vary much as to the special tissues or organs which are most prone to suffer under it. Thus, some catch cold almost solely in the mucous membrane of the nasal passages and pharynx; in others, the tonsils, throat, and larynx are much more prone to suffer; in others, the bronchial mucous membrane, etc." To these two diatheses, therefore, I trace the heredity of the majority of the diseases of the respiratory system, for it will be found that by far the greater number of them are included under the heads of scrofulous or other well-recognised constitutional and heritable conditions, and under that of the universally-developed catarrhal diathesis. Thus under the head of scrofulous diathesis may be included chronic tubercular phthisis, acute miliary tuberculosis, pleural tuberculosis, and, perhaps, gangrene of the lungs; whilst under that of the catarrhal diathesis we may range croupous and catarrhal pneumonia, croupous or fibrinous bronchitis, bronchitis, croup, coryza, rhinitis blennorrhoeica, acute and chronic laryngitis, catarrhal tracheitis, bronchial catarrh, pleuritis, tonsillitis, etc. In this list I do not include pulmonary emphysema, and bronchial asthma, which are, however, well-known to be hereditary. Various other so-called diseases of the respiratory organs might be mentioned, as pneumo-thorax, hydro-thorax, haemoptysis, atelectasis (often congenital), oedema, etc., but as these are for the most part merely symptomatic of other diseases, I shall not now further allude to them.

What I am contending for is not that all the diseases of the respiratory system are hereditary or heritable as such, but that in the case of each of them there is a predisposition which is inherited by every individual affected by them;

and that this predisposition of tissue, cell or membrane, unless neutralised or held in check by marriage into a different stock, will inevitably reveal itself, and if not in one generation, it will assuredly in the next; for as Dr. Maudsley says: "A disease-tendency, which is latent or dormant at one period of life, or throughout the whole life of the individual, may undergo actual development at a particular physiological epoch, or on occasion of a great bodily crisis from some other cause; and a tendency which is latent or dormant in one generation may show itself in the next generation." Nothing in nature is lost, and whether for weal or woe to the individual, her laws are inexorable, and must be obeyed. Heredity is the law as affecting the characters of the species; whilst the individuals are subject also to that of variability, thus necessitating the differentiation of individuals. On the whole, however, we inherit from our ancestors and parents not only our bodies and our minds, but a predisposition to their diseases; and of the latter none more surely than those of the respiratory system. For of the diseases of the respiratory organs, nearly all have their source and origin in the scrofulous and catarrhal diatheses, and these in themselves the result of inheritance in past ages have been handed down to us, modified or intensified as the case may be, by our fathers.

*Diseases of the Kidneys, etc.*—That a predisposition to diseases of the kidneys, bladder, and generative organs, is hereditarily transmitted, and characterises certain families for generations, is a fact which cannot be denied; and if my arguments as to the influence of heredity in the diseases of the circulatory, nervous, and respiratory systems are of any avail, we shall have no difficulty in understanding why this is and must be so. For the human body being subject

to the law of heredity in its every organ and tissue, it assuredly follows that what is true physiologically and psychologically, must, as a natural sequence, be true also pathologically. We are prone to talk of the constitution of an individual. What do we mean by the term, and what does it involve? A sound constitution has been defined as the harmonious development and maintenance of the tissues and organs of which the body is made up. Whence does it originate? From the union of a healthy sperm and germ cell in the maternal womb. To this same union I have already traced the source of heredity: so that every constitution has its foundation laid, and its deficiencies and potentialities developed and maintained in accordance with the law of heredity, to which they are alike subject from the time a germinal vesicle is produced by the fusion of the germ with the sperm cell. Irrespective of the *definite inherited forms of disease* which contribute to constitutional unsoundness, the latter condition may also be the result of defective or *deficient vitality*, which may be general or local. When general, this deficient vitality is frequently observed in "the children of parents one or both of whom are in advanced life, or whose vitality on one side or the other has been reduced by excesses, such as alcoholic or venereal. Exhausted vitality from prolonged disease, *e.g.*, phthisis or tertiary syphilis, affecting either parent, may determine the death of the offspring at an early period from mere failure of nutrition, or may cause it to succumb to acute disease not necessarily associated with any inherited tendency of a special kind." Deficient vitality may also be local, *i.e.*, affecting only certain tissues and organs, or involving certain systems, as the nervous, the respiratory, the vascular, generative, or digestive; and amongst those

diseases which are the most assuredly and markedly hereditary, none are more so than those of a degenerative form, including structural heart diseases, atheromatous vessels, emphysema, certain diseases of kidney, etc. All these partake of the nature of premature senility of organ or tissue, consequent upon some inherent deficiency in their vitality. "Although the constitution of an individual begins with his life, it is nevertheless the resultant of the constitutional peculiarities of many antecedents. This being so, tendencies to disease may date far back in the pedigree, to be called forth from time to time by favouring circumstances." What we have practically to remember is, that in addition to such definite inherited forms of disease as congenital syphilis, gout, scrofula, tuberculosis, cancer, asthma, and several neuroses, the relative soundness or unsoundness of individual constitutions is also dependent upon a local or general defectiveness of vitality, which is hereditary, and which will tend to develop disease in the impaired organ or tissue. Constitutions are liable to be rendered unsound, not only by definite inherited forms of disease and defective vitality, but by the wear and tear of life in its environment. Here again we have the constitutional vigour so impaired, subsequently to birth, by pernicious surroundings, that constitutional diseases are thus engendered and passed down as a legacy to be inherited in future generations, in the form of scrofula, rickets, phthisis, etc.<sup>1</sup>

We thus see that there is no organ or tissue of the human body which is not subject to heredity in disease as in health: the fact being that, in one as in the other, like begets a predisposition to like, capable of being modified by variability, or even neutralised by marriage into a new

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<sup>1</sup> Dr. Douglas Powell.

stock, for a generation, but never lost. A predisposition to degenerative diseases of the kidney is therefore as much a fact as that scrofula or phthisis are the results of the development of a pre-existing disposition in the organs or tissues affected by them. The three degenerative diseases of the kidney known under the generic name of Bright's disease will afford an example. The first, or inflammatory form, may be acute or chronic, and usually affects the tubules; the second, or waxy, lardaceous, amyloid or albuminoid is degenerative, and originates usually in the vessels; whilst the third, the gouty or cirrhotic form, is also degenerative, and originates in the fibrous stroma. What has heredity to do with these conditions? Let us seek our reply in the etiological sources of each of these affections. The inflammatory affection is said to be caused by exposure to cold, and by scarlatinal and other blood-poisons: the latter I shall consider presently, when I come to deal with heredity as affecting the acute infectious diseases. With regard to exposure to cold, we have already seen that the catarrhal diathesis is universal, but may be, and is, differently distributed in different individuals. Let us suppose, for example, that a parent has in early life suffered from this inflammatory affection of the kidneys, however caused: however competent to discharge their functions afterwards, the kidneys during his life will bear the brand of what they have suffered—they will be *somewhat* different from what they were originally. This parent has a child or children who have, in common with humanity, inherited the catarrhal diathesis, subject in his or their cases to the combined catarrhal predisposition of both father and mother. From what we have already seen of the action of heredity, is it too much to assume that one of

the father's children will inherit a predisposition to the pathological taint in his father's kidneys, and on exposure to a similar cause will almost inevitably suffer from a similar affection? I trow not; but, unfortunately, I have no cases at my disposal to bear out my argument. At any rate, it is easy enough to adduce cases of like heredity in reference to other organs and tissues, and if so in these, why should the kidneys be excepted? I firmly believe that as every vestige of the human body is subject to heredity physiologically and psychologically, so it must be, and is, with regard to its pathology: for disease is but impaired function or degenerative change; and if, in health, every cell, membrane, muscle, bone, and viscus—every element of man in his dynamism—is subject to the law of heredity, by a parity of reasoning, I cannot see why, if certain morbid conditions are universally recognised as hereditary, a predisposition to every morbid condition may not be traced to the same influence.

The waxy or amyloid disease of the kidneys is said to be caused by phthisis, syphilis, caries, profuse suppuration, and other exhausting conditions, and is often associated with waxy degeneration of other organs, especially the liver, spleen, and intestinal canal: in fact, it might be defined generally as a constitutional condition dependent upon the scrofulous diathesis. As in the foregoing, and for similar reasons, this condition is capable of being transmitted hereditarily, at least, so far as a predisposition to its development is concerned. The gouty or cirrhotic form of Bright's disease depends for its causation upon alcoholic intemperance, the poisons of gout and lead, and others conditions which are unknown. In the course of its development, hypertrophy of the heart, with sclerosis and

degeneration of the vessels are frequently associated with it, insomuch that Sir William Gull and Dr. Sutton regard the affection as only symptomatic of a constitutional condition characterised by hypertrophy of the walls of the small arteries, due to a fibroid growth in the external coat of the vessels. Dr. George Johnson, on the other hand, regards the hypertrophy as "a consequence of the obstruction which impure blood invariably meets with in the capillaries." Whichever view may be correct, I have certainly seen cases in which the cirrhotic form of kidney disease was associated with cirrhosis of the liver, sclerosis of the blood-vessels, mitral stenosis, and curiously enough, with sclerosis of the posterior columns of spinal cord. There is, at least, much in favour of the belief that the so-called "gouty kidney" co-exists with a constitutional condition, however imperfectly understood, and that like all other constitutional conditions, it is capable of being transmitted, as a predisposition, hereditarily. I have chosen the three forms of Bright's disease as illustrative of my argument because in themselves they constitute the most important of the diseases of the kidney; but I might readily have included syphilitic, malignant, and tubercular disease, suppurative inflammation, acute and chronic atrophy, cystic, hydatid, and fatty disease, pyelitis, etc. Those to which I have referred are, however, I trust, sufficient to show that as in every other organ and tissue of the human body, the kidneys are similarly predisposed to disease, and that this predisposition is hereditarily transmissible.

Renal and vesical calculus—similar morbid conditions—are undoubtedly hereditary. I could adduce many striking instances of this fact, but the following will suffice:—The first case is mentioned by F. Hoffman. The Lady of the

Prince Moritz of Zeitz was afflicted with nephritis ; she was delivered of a daughter, who, from the moment of her birth, suffered very great pains, especially when passing water. The child lived only three weeks. At the *post-mortem* examination there was found in the bladder a stone as large as the stone of a peach (*instar mali Persici*). Gaubius, as alluded to by Steinau, assisted at a lithotomy performed on a boy of ten years of age, whose father had, twenty-five years before, undergone the same operation. The father, upon seeing the stone taken from his son, assured them that it was quite like that taken from himself. Gaubius compared them ; and found they were indeed like each other in every respect, except in size, the father's being somewhat larger than that of his son. There is also the well-known case of the Perigordian philosopher, dear, quaint old Montaigne, who suffered severely from stone in the bladder, which he had inherited from his father. Stahl also assures us that he never saw a person suffer from lithiasis, whose father or some other near relation had not been afflicted with this same complaint, or with gout.<sup>1</sup>

The different maladies peculiar to women, according to the opinion of the most skilful observers, frequently occur hereditarily, or are transmitted as a predisposition to the same. Nothing is of more frequent occurrence, says Stahl, than to see all the different irregularities of the menses, pregnancy, puerperium, the milk, etc., that had taken place in the mother, appearing also in the daughter ; and every observant physician must have frequently noticed this fact. The relative susceptibility of individuals to the syphilitic and gonorrhœal virus—to stricture, catarrhus vesicæ, enlarged prostate—all of which involve a hereditary

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<sup>1</sup> Dr. Steinau.

element, might be here noticed, but I shall allude to some of these affections hereafter. I therefore, maintain, that in all diseases of the kidney and genito-urinary tract there is a pre-existing heritable disposition of tissue and organ, whether of late or early descent, and that this view is well supported by facts in every-day practice, if they are only recognised and appreciated aright.

*Diseases of the Chylo-poietic System.*—The mere enumeration of these diseases would monopolise almost all the space at my disposal for their consideration. I shall, therefore, content myself with some brief general remarks as to how they are affected by heredity. If there is any truth in my previous statements regarding the diseases already considered, and if my arguments have anything to recommend them, it follows, by analogy—if I have established as a fact that pathological processes are subject to heredity because the physiological and psychological nature of man is undoubtedly inherited, although subject to individual modifications—that what is true of one system must be true of all, and that as every tissue and organ in the human body bears the brand of heredity in the discharge of their every function in health, so must they also in disease, which I regard as functional derangement or degenerative change in tissues or organs which have been inherited. Again I must guard myself from being misunderstood. I do not mean that the diseases of ancestors or parents must inevitably be transmitted to their children (although such cases occur, perhaps, more frequently than we wot of); but what I contend for is that the physiological and psychological natures of ancestors and parents being handed down to their children, with certain individual modifications, it must follow that the brands of disease

upon, or the taints of disease within their tissues or organs, must be likewise transmitted as predispositions to the same. When considering the physiological and psychological aspects of heredity, in this series of papers, I think I proved without a doubt that there was no element of man either in his organism or in his dynamism that was not subject to the law of heredity; and if this is so it seems to me but a natural consequence that with his organic or dynamical peculiarities he should also transmit a predisposition to the weakness or deficiency of his tissues or organs produced by disease in himself, to become re-developed in his children under circumstances favourable for such development.

With regard, however, to the diseases of the stomach and intestines, of the pharynx and oesophagus, of the peritoneum, of the spleen and pancreas, if heredity and variability necessitate the fact that these organs differ from each other not only organically, but functionally in the cases of different individuals, and that in no two individuals are they precisely the same either in their organic potentialities or functional peculiarities, it assuredly follows that they are differently predisposed to organic and functional derangements and diseases, and it is only fair to assume that heredity and variability are also responsible for this fact. It is at least safe to affirm that all the diathetic diseases—tubercle, scrofula, cancer, syphilis, gout, *et hoc genus omne*—are markedly hereditary, and that every organ and tissue of the chylo-poietic viscera are subject to each and all of these diseases admits of no doubt. Of other morbid conditions of the chylo-poietic system which are frequently inherited I may mention helminthiasis, haemorrhoids, dyspepsia, hernia, *fœtor oris*, and dropsy; to these might be

added many kindred conditions, but those mentioned will suffice. With regard to helminthiasis it is a fact, as proved by daily experience, that the children of parents who are infected by intestinal worms (especially *ascaris vermicularis* and *ascaris lumbricoides*) are also attacked with these parasites, often at a very tender age, when they cannot have been caused by any noxious influences; and sometimes even from their very birth. Dr. Steinau says he had frequent opportunities in the Hospital for Diseased Children, in Berlin, to assure himself of the hereditary character of this complaint. The hereditariness of haemorrhoids is of too frequent occurrence to render it necessary to enlarge upon it. Who has not witnessed dyspepsia, in its protean forms, handed down from parent to child, and been struck by the frequency a patient will say "My father (or mother) had a very weak stomach too?" Hernia has been known to have been inherited through many generations. Many competent writers, says Steinau, have cited cases to prove this; and Richter saw several children, whose fathers were ruptured, suffering from the same complaint, having in each case arisen without any external cause, and quite spontaneously. Speaking of dropsy, Rougemont, supported by the testimony of several credible writers, says that it is proved by numerous observations that the children of such parents as have died of dropsy became at a certain age also dropsical. Many cases have been noticed of dropsical women being delivered of dropsical children—particularly one case quoted by Hufeland, and observed by Olivier. Chronic foetor oris, which does not appear to be produced by any visible local cause, is also often hereditary.<sup>1</sup> To these might be added abdominal cramp, flatulence, constipation, pyrosis, and many other allied conditions.

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<sup>1</sup> Steinau.

Regarding the diseases of the chylo-poietic system as a whole there is scarcely one of them to which heredity cannot be said to have predisposed. Of course the influences of life and circumstances have to be estimated in every case as factors in the production or development of disease ; but I maintain that in almost every case there is a pre-existing disposition which has been inherited, and which acts as the source from which morbid processes spring, or as the foundation on which they are laid. To quote an illustration already given, why should several individuals exposed to the same noxious influence—say a chill—be so differently affected ? One will have as a consequence an attack of influenza or bronchial catarrh, another sore-throat, another rheumatism, another bronchitis or pneumonia, another lum-bago, and so on. Why are some individuals so prone to attacks of erysipelas, biliaryness, sick-headache, etc. ? Because they differ from each other as individuals in power of resistance ; because of pathological habit ; but principally because of constitutional predisposition which in nine cases out of ten, will be found to rest upon a basis of heredity. Their fathers or mothers may be found free from any such affection as the children respectively suffer from ; but this is not enough to prove their non-hereditary origin. We must enlarge the cycle of heredity and inquire further back in the pedigree, and if this inquiry also gives a negative reply we must remember that hereditary diseases are somehow mysteriously related to each other, and may in many instances be found vicarious ; thus it is possible that the father may suffer from haemorrhoids, and the son from dropsy ; or the first from gout and the latter from stone ; but still in these cases the dropsy as well as the stone must be considered as hereditary.

Try as we may, there is no such thing as getting rid of heredity, for it is the inexorable law of our being. No force in Nature can be lost; and as whatever we *have* or *are* we owe to heredity, save the action of our environment, we must bow to the inevitable, and admit that as our physiological and psychological being is subject to the action and interaction of this great law within us, so also we are more or less predisposed to the morbid processes which assail us during our lives, and that these predispositions we shall pass down to our children, however ignorant we may be of the fact, or however we fail to recognise or appreciate it. As the past slumbers in each one of us, so do the potentialities of the future—the welfare and commonwealth of our race!

*Hepatic Diseases.*—The foregoing arguments as to the influence of heredity in diseases and disorders of the kidneys and chylo-poietic viscera, apply with equal force, for obvious reasons, to diseases and disorders of the liver. I need not here recapitulate them in any detail. Of the degenerative diseases of the liver—cancer, cirrhosis, amyloid degeneration, fatty infiltration, etc., it may be safely said, irrespective of their proximate causation, that, at least the majority, if not all of them, are dependent upon constitutional conditions, and that a predisposition to each of these, either in the person of the afflicted parent or of his children, is more or less, but almost invariably, inherited. Let us briefly consider these diseases of the liver in the above-mentioned order, and with especial reference as to how they are affected by heredity. With regard to diseases of the liver in general, Frerichs in his great work remarks that “the data heretofore established are not sufficient to secure to heredity a positive influence.” That he was at least mistaken with regard to hepatic cancer,

there cannot be the least doubt ; and if in one case, why not in all ? It is only fair to assume, that at the time this distinguished and original writer published his *magnum opus* (1858), the subject of heredity in relation to disease was comparatively little understood, and that the mind of the author had not been especially directed towards its consideration. It has long been generally acknowledged that the heredity of cancer is well established, and "that which applies to cancer, in general, self-evidently and as a matter of experience, equally applies to cancer of individual organs."<sup>1</sup> Statistics are not very reliable as a rule, but even these prove without a doubt that cancer is hereditary. Thus of 1127 cases reported by Paget, Cooke, Sibley, Lebert, Lafond, Hess, Moore, and others, 192, or 17 per cent. were found to have been inherited ; and I have already elsewhere recorded a case in the practice of the late Dr. G. H. Barlow, in which a lady was the fifth victim of cancer of the liver in two generations.

In such a case as the last, one cannot fail to be struck with the hereditariness of cancer ; but it should never be forgotten that, although diseases and predispositions, being subjected to the influences of other diseases and predispositions, are not unfrequently reproduced hereditarily in a modified form, yet that the heritable influence always exists in one form or another. Cirrhosis of the liver offers a case in point. What are its causes ? (1) Spirit drinking, a predisposition to which is undoubtedly heritable ; and who can say that a predisposition to its *effects* corporeally is not also transmissible ? (2) Syphilis ; can there be any doubt as to the inheritance of this disease ? (3) Malaria, as we have seen in the consideration of the malarial diathesis, is

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<sup>1</sup> Leichtenstern.

potently hereditary. The other known causes of cirrhosis of the liver are subsidiary, and need not here be considered. Here then we have an affection, the three main causes of which are indubitably subject to heredity, and however diverse in their nature, yet tend to produce a well-known disease of the liver! Here we have an example of the manifold and complex influences of heredity on the human system in relation with its diseases, and it should always be remembered that there are many cases in which, although like cannot be said to produce like, yet the influence of heredity is potent and effective. When alluding to cirrhosis of the kidneys, I stated that it was frequently observed as part of a constitutional condition characterised by fibrotic changes in vessels and organs; these observations are, however, still *sub judice*, so I shall not insist upon their accuracy, but I have, at least, shown that the causes of cirrhosis of the liver are mainly heritable, and if so, I cannot see why their effects should not be so also. If a predisposition to allied pathological changes or conditions is inherited, as it unquestionably is, I fail to recognise the mode of reasoning which would exclude cirrhosis of the liver—or at least a predisposition—from the same category.

Amyloid degeneration, whether of kidneys, liver, or other organ, never appears as a primary affection, but as the result of a pre-existing general cachexia, induced by various morbid conditions usually associated with prolonged suppuration, ulceration of bones and joints, also of soft parts (as in empyema), or with chronic pulmonary phthisis, constitutional syphilis, or other chronic constitutional diseases. Like most other constitutional conditions, the cachexia, however induced, may be transmitted, whether associated with amyloid degeneration or not; and what is still more to the point,

according to Rokitansky and other observers, amyloid disease, and especially amyloid disease of the liver, has been known to occur actually as a congenital condition in cases of hereditary syphilis. There is therefore no reason why a predisposition to amyloid disease of the liver or other organs should not be inherited. If not a product of the scrofulous diathesis, amyloid disease is certainly the resultant of a pre-existing condition closely allied to it.

I may dismiss the consideration of fatty infiltration, or fatty degeneration of the liver, in a few words. Both may be regarded as modifications of the natural fat-forming process ; in the first case being brought to the liver-cells with the blood ; in the second, originating in the interior of the liver-cells themselves, from the albumen belonging to them. The first partakes of the nature of that general condition which we term obesity or corpulence, a predisposition or tendency to which is handed down from one generation to another ; the second partakes of the nature of metamorphosis—fatty atrophy of the cells, resulting from the non-restoration of albumen expended in the preparation of fat. This latter condition is also hereditary, and may involve other organs than the liver, as the heart, etc.

Passing now from degenerative diseases to functional derangements of the liver, I may here briefly allude to chole-lithiasis or gall-stones, icterus or jaundice, hepatic congestion, and “biliaryness,” which are all more or less hereditary. Fauconneau-Dufresne asserts that gall-stones are frequently hereditary, basing his assertion on the experience of the bath physicians at Vichy, who have so many opportunities of observing every kind of liver disease. Be this as it may, we cannot say that gall-stones, or a predisposition to them, are not hereditary. simply because from our inexperience or

ignorance we cannot say whether they are or are not. If the views enunciated in the foregoing pages have anything to support them, we should have no difficulty in understanding why gall-stones should be hereditary, like other morbid results, and we can only trust that time and experience will ultimately clear the way from every doubt, either one way or the other. Icterus or jaundice is also hereditary; thus Kerkring mentions an example of a woman afflicted with jaundice, being delivered in the eighth month of her pregnancy of a still-born child, whose very bones had a yellow colour. This case seems to support the views of such pathologists as Hartmann, Conradi, and others, who believe that in many cases, instead of a mere predisposition communicated by the parents to their children, the disease itself is inherited; and they appeal to experience, by which it is proved, as they allege, that many children are born with diseases under which their parents suffered. We must acknowledge that deformities generally, and especially anomalies in the external parts, as varus, sex-digitism, also diseases of the eye, especially cataract, if inherited are brought into the world with the children; but, on the other hand, in the majority of so-called internal diseases, a predisposition only is more frequently inherited. Probably the true explanation may be found in the following circumstances—viz., that with respect to the majority of internal diseases, it often depends upon the more or less high stage to which the disease has arisen in the parents, whether they communicate to their children merely a predisposition, or the disease itself. How it happens, however, that sometimes the predisposition only, and sometimes the disease itself, is communicated, must, like many other questions, for the present remain unanswered. In addition to the case of

hereditary jaundice observed by Kerkring, many other observers have seen interesting cases of women, afflicted during their pregnancy with icterus, having been delivered of jaundiced children. No less scarce are the cases where all the members of a family have been attacked by jaundice at the same age; and an especially remarkable one is described by Boerhaave.<sup>1</sup>

That there is an especial predisposition on the part of the patient to the hepatic congestion induced partially by dietetic irregularities, peculiar to middle life, cannot be doubted, and if we consider how different individuals are differently affected by free indulgence in innutritious diet and irritative articles of food, whilst at the same time leading a sedentary and inactive life, the reason is not far to seek, for as individuals differ from each other in every respect, physiologically, psychologically, and pathologically, so must each individual differ from every other in his inherited tendencies. How else can we explain the reason why amongst a set of freely-living indolent men one will suffer, in consequence of his mode of life, from hepatic congestion, another from obstruction, another from constipation, another from haemorrhoids, etc., while others remain free from any such disorders? Apparently the mode of life has much to do with the production of such conditions, but primarily, the inherited predisposition influencing every organ and tissue of different individuals in various ways and degrees, alike in health and disease, constitutes the real reason. Virchow has already demonstrated very considerable individual differences in the conditions of the arterial walls: why then should the occurrence or non-occurrence of the above-mentioned conditions under precisely similar circum-

stances not be accounted for by individual differences in the condition of the walls of the vessels belonging to the portal system ; nay, more, to individual differences in the development, nutrition, and innervation of the muscular tissue of the intestines ? These relative individual differences of bone, tissue, cell, organ, membrane, and vessels, which are admitted by all competent authorities, really form the foundation of all sound views in pathology, and the more they are recognised and appreciated, the more will the art of medicine acquire scientific exactitude and increased usefulness to humanity. In the words of Sir James Paget, " Better treatment will follow better diagnosis, and better diagnosis will certainly follow a more exact pathology." Professor Thierfelder, of Rostock, says : " The predisposition to habitual hepatic congestion is often inherited, and may then appear in the same families for many generations. It must obviously be admitted that there may exist a similar predisposition towards a menstrual hyperæmia of the liver. A somewhat analogous condition is suggested also in that form of hyperæmia due to obstruction. In certain affections, for instance, it is not always the liver, but frequently the kidneys or the mucous membrane of the digestive apparatus, that constitute the organ in which the results of over-distension of the entire venous system first of all and most distinctly appear ; and with reference, moreover, to the degree of the alterations in the liver, the separate cases present varieties which are by no means invariably proportionate to the extent of the obstructions to the circulation, in consequence of which, as is stated by Botkin, the susceptibility of the liver to the effects of an increased venous pressure cannot be the same in all individuals."

Biliousness, or bilious attacks—however vague the terms, and however incorrectly applied—are very frequently merely attacks of acute dyspepsia or migraine. According to Dr. F. T. Roberts, the most prominent symptoms of a supposed bilious attack are anorexia, furred tongue, a bitter taste, sickness, constipation, and headache, with a feeling of marked depression and general malaise. However such attacks may be designated, everyone knows, at least, what is meant by a bilious attack ; and although the liver may have little or nothing to do with them, yet they have from the earliest history of medicine been associated with biliary derangement, and as such they are still popularly regarded. Irrespective of their causation, there can be no doubt that a predisposition to them is frequently inherited, a fact which is demonstrated unmistakably in every-day practice. So far as I know, this is the only case in which temperament may be confounded with diathesis ; but as the former term does not imply any proclivity to disease, we may assume that those predisposed to bilious attacks have inherited a constitutional peculiarity which might be more aptly described as of the nature of a bilious diathesis, owing to intensification during transmission. However we may map out the differences between families or individuals, a certain amount of elasticity must be allowed, as they cannot be regarded as hard and fast lines. Thus when we employ the terms—temperament, diathesis, idiosyncrasy, etc., to designate certain classes of individuals, we must remember that no individual can be regarded as a pure unmixed type of either sub-division : no arbitrary line may be said to divide the one from the other, although heredity and variability are the two laws to which they are all subject, and from which all individual differences arise. The above terms can only be

regarded as indicating in broad characters the sum of certain types of individual differentiation, and for all ordinary purposes they are explicit enough, as they are easily understood, and without embodying the whole truth, are yet verified by experience. At the same time, it must not be forgotten that every individual presents such a mingling of temperaments, diatheses, etc., that for anything beyond the broadest outlines we must seek still deeper, and further backwards into the long descent of constitutional peculiarities. Whether this bilious predisposition be included under the name of temperament or of diathesis, or of both combined, the fact is, that instead of being as much a distinct type as the other diatheses, it is often rather a modification of, or co-existing with, others. Thus it is frequently associated with the gouty or strumous diatheses, and with the nervous and lymphatic temperaments, and, as Dr. Milner Fothergill says, to recognise such combination in practice, and in the selection of remedial agents, is often more practically useful than an elaborate physical diagnosis, and is especially useful when physical diagnosis is not readily attainable. Whether also the liver, stomach, spleen, pancreas, intestines, or nervous system, be primarily involved in the production of those attacks usually denominated "bilious," the fact is, that they depend, as a rule, upon constitutional peculiarities of viscus, tissue, membrane, cell, vessel, or nerve, which evidence a predisposition, not only inherited, but also transmissible. I have known cases in which these so-called bilious attacks have characterised parents and children through several generations, and the same fact has doubtless been frequently observed by others; and, curiously enough, I have seen individuals in whom the bilious temperament seemed to preponderate, but who had never experienced a

bilious attack in their lives. These and similar anomalies indicate the imperfections of the most scientific grouping of the differences between man and man, but like the ideal law of heredity which is never attainable, these groupings, if necessarily imperfect, are yet satisfactory enough to merit the recognition of experience in the present light of scientific inquiry. Like all other sub-divisions of natural laws, they consist of groups of phenomena which, however imperfect or incomplete in detail, are yet sufficiently capable of indicating their dependence upon the parent law as to demonstrate its existence, and in what direction we must seek for the causes of which they are the effects.

When alluding to the temperaments, I was careful to define the term as "applicable to the sum of the physical peculiarities of an individual, exclusive of all definite tendencies to disease," as no special proclivity is involved by them, and stated that they ought to be regarded as merely physiological peculiarities forming a part of the original organisation of the individual. To the original four temperaments—viz., sanguine, nervous, bilious, and lymphatic, Dr. Laycock added two more—viz., the phlegmatic and melancholic; but of these, I agree with Mr. Hutchinson, in regarding the bilious and the melancholic as simply different degrees of the same thing, and that, as life advances, the one is very apt to pass into the other; moreover, that the distinguishing feature in both is one which concerns disease rather than temperament, and which might be more conveniently known as the *hepatic diathesis*. For, as Mr. Hutchinson continues: "It is the proneness to disordered function on the part of the liver, its ready and frequent occurrence, which for the most part stamps peculiarity on both these so-called temperaments. Further, it is much to be doubted

whether this facility to hepatic disturbance would be found in association exclusively, or even generally, with any particular cast of the features, or recognisable peculiarities in the general frame." Be this as it may, it appears absolutely necessary that we should recognise a hepatic *diathesis*, the possession of which is usually characterised by oft-recurring attacks of biliaryness, and that like the majority, if not all, of the diatheses, this also is hereditary. It is thus advisable to distinguish between the biliary temperament and the biliary or hepatic diathesis—the former being a question of physiology and race, if not of diathesis also; the latter signifying an easily recognised morbid proclivity, which is pathological and unquestionably hereditary.

I have now considered the principal degenerative diseases and functional derangements of the liver, with a view to tracing the influence of heredity in each, and we have seen in the degenerative forms of disease referred to, that they each depend upon a pre-existing disposition which is constitutional, and may be transmitted from parents to children, or from one generation to another. We have also seen that the various functional disorders of the liver are subject to the same influences. In the cases of some of the diseases and derangements alluded to, the evidence may not be so strong as in those of others; but in making, so far as I know, the first attempt to show that the pathological processes, no less than the physiological and psychological processes in man are subject to heredity, and in viewing for the first time the entire field of human diseases with that object, some allowance should, I think, be made, if I have been unable to prove my argument in every case alike, especially as the entire subject is comparatively new and hitherto unworked. Here and there the evidence is positive

enough; in other cases it may seem neutral, or even negative; but I feel assured that the more attention is directed to the systematic and painstaking accumulation of facts, the more will the positive and confirmatory evidence increase, and the more plainly will it be revealed that, as our bodies and minds are dependent upon heredity, so also does a predisposition to the diseases of both depend upon this great law of our being.

*Diseases of the Locomotive Apparatus.*—In this group are included the rheumatic affections of the joints and muscles; also those other disorders generally associated more or less with rheumatism—gout, arthritis deformans, rickets, and mollities ossium.<sup>1</sup>

In considering the influence of heredity on this group of diseases, I shall at once refer to that feverish constitutional malady known as acute rheumatism (*polyarthritis rheumatica acuta*) without staying to discuss how the progress of morbid anatomy, and the comparative perfection of our diagnostic methods, in these latter days, have restricted the domain of ancient “rheumatism”—a term which once denoted far more than it does now. I think I need have no hesitation in stating that a predisposition to acute rheumatism is distinctly and emphatically hereditary, and that it tends to run in families: indeed, some recent observations on the transmission of a predisposition to this affection, by Fuller, Lebert, Picot, and other authorities, prove incontestably that the inheritance of such a predisposition is of very frequent—if not of invariable—occurrence, in those cases which are not acquired. In the case of rheumatism, this inheritance, says MacLagan, seldom declares itself before fifteen, and is generally lost again after fifty. What is transmitted is not the disease, but a tendency to it—a greater or

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<sup>1</sup> Ziemssen, vol. xvi.

less liability to contract it: that peculiar condition of the tissues of the motor apparatus which renders them a fitting nidus for the propagation of the rheumatic poison. He continues, "That some peculiar condition of the motor system is handed down in rheumatism, we know. That this condition declares itself by a special susceptibility of the tissues of the motor apparatus to the action of the rheumatic poison, we also know—but more than this we cannot say—for in this, as in all other cases of hereditary transmission, we can only indicate, not explain, the fact." Acute rheumatism is one of those diseases, an attack of which so affects the tissues of the motor apparatus as to render them peculiarly susceptible to further and more aggravated attacks; so that, *cæteris paribus*, the more strongly the rheumatic habit is thus developed, the more potent will be the influence of heredity in its transmission. The real nature of the rheumatic poison is still *sub judice*; but whatever revelations science may yet make as to this interesting question, there can be no shadow of doubt that a predisposition to acute rheumatism is recognised by experience; also that this predisposition is indubitably and strikingly hereditary.

It may be regarded as an axiom that the more a disease is constitutional, the greater will be the influence of heredity in its transmission; we can, therefore, easily understand why there should be some doubt as to whether chronic articular rheumatism is hereditary or not, being essentially a local affection. Bearing in mind, however, the fact that the majority of those who suffer from it, have already in earlier life undergone an attack, or attacks of acute rheumatism, and that the former affection is almost exclusively confined to the latter half of life, it certainly seems as if it were a

*sequela* of acute rheumatism (which generally attacks predisposed persons), and if, as is admitted, this predisposition is transmissible, there seems no reason to doubt that to some extent, at least, a predisposition to this *sequela* may also be inherited. All constitutional affections, unless neutralised by circumstances, as marriage into a new stock, must be inherited in some form or degree; but it is not necessary that the inheritance transmitted to the child should be exactly alike, or assume the identical form characteristic of his parent. I have already referred to metamorphoses in transmission, which account for such facts as the scrofula of one generation becoming tubercle in a subsequent one, or cancer alternating with tubercle or scrofula: we must not on this account deny the potency and efficacy of heredity, which is the rule, however individual peculiarities may differ, but rather believe that, despite such metamorphoses and dilutions which we may not be able to understand or appreciate, the law of heredity is inexorable, and like all other natural laws its potency can never be lost. In this way we may account for the fact of a constitutional affection like acute rheumatism—or rather a predisposition to it—being inherited, whilst the effects of heredity are less potent as regards one of its local *sequelæ*, chronic articular rheumatism. That any one, however, who has inherited a predisposition to acute rheumatism, subsequently suffers from it, and later on in life develops chronic articular rheumatism, can in turn transmit a predisposition to the one, without, at the same time, transmitting some susceptibility to the other—however diluted or whatever form it may assume, I, for one, cannot admit. The one thing we have to remember is that heredity is the rule; that, however, it may be altered by circumstances in form or degree, its

efficacy still exists, and this, notwithstanding the fact that we may not be able to recognise it. I therefore contend that chronic articular rheumatism being most frequently a *sequela* of acute rheumatism, and a predisposition to the latter being transmissible—that although the latter is constitutional and the former local, they stand towards each other as cause and effect, and consequently a predisposition to the one must include to some extent a predisposition to the other. In the same category may be included myalgia, lumbago, etc., which, whether dependent on inflammatory changes in the muscular or the interstitial connective tissue, or neuro-pathic conditions, are decidedly hereditary, as is proved by every-day experience. I have myself known families, members of which have suffered from attacks of lumbago in one generation after another, and we have all seen the same thing occur as to rheumatic cephalgia, intercostal rheumatism *et hoc genus omne*.

In approaching the consideration of the heredity of gout, I am fortunately assailed by neither doubt nor difficulty, as in the vast majority of all cases of gout, it occurs in consequence of an inherited predisposition, and this is admitted by all authorities. Out of 523 gouty persons, Scudamore found that 309 had come from a gouty stock ; Gairdner, 140 out of 156 ; Garrod 75 per cent. ; and Braun, out of his sixty-five patients, did not find one whose parents or grandparents had not suffered from the disease. Dr. Garrod, in his classical work on "Gout and Rheumatic Gout," instances the following cases :—"A few years since, I was consulted by a gentleman labouring under a severe form of gout, with chalk-stones, and, although not more than fifty years old, he had suffered from the disease for a long period. On inquiry, I ascertained that for *upwards of four centuries* the eldest son

of the family had invariably been afflicted with gout when he came into possession of the family estate." He also relates the following case, which illustrates the terrible influence of heredity in connection with the disease now under discussion: "A gentleman, forty-eight years of age, whose health has been good with the exception of attacks of gout, which commenced at the age of thirty-six in one great toe. The attacks gradually became more frequent, and more prolonged, so that he was scarcely ever free from them." Dr. Garrod thus sums up the hereditary influence in this case: "The father had very severe gout, the mother, when seventy years of age, began to suffer from it; he has had six brothers, of whom one died of very severe gout, and was crippled from chalk deposits in both upper and lower extremities; another had severe gout and chalk-stones, and died of albuminuria; a third had gout and paralysis, of which he died; a fourth had gout, and died of erysipelas; a fifth died of gout, complicated with some urinary affection; and a sixth is alive, but suffers from gout in the same way as the patient himself." Gout occurs much more frequently in men than in women, who seldom suffer from it until after the menopause; the predisposition is, therefore, more frequently inherited from the father's side, than from that of the mother; moreover the tendency may often be traced to the grandparents, while the parents themselves remain free, especially if they have been careful to avoid the exciting causes of the gouty attacks. Heredity also influences the time of life at which the gouty paroxysms supervene; thus, in those persons who have an inherited predisposition, the attacks come on at an earlier period than those who have an acquired tendency; in the latter, gout usually makes its first appearance between thirty and forty, but in those

hereditarily predisposed it may manifest itself at a much earlier period. Gout is not only a very serious malady in itself, but may become the parent of grave constitutional and functional disorders and diseases. Of these the following may be here enumerated—viz., of the digestive organs: gastritis, neurotic disturbance, dysphagia, intestinal colic, diarrhoea, and hepatic derangement; of the nervous system: headache, vertigo, mental disturbance, delirium, mania, epilepsy, neuralgia, cramp, local paralysis, meningitis; of the heart: slow, rapid, weak, irregular, or intermittent action, syncope, collapse, and various painful and disagreeable sensations; of the lungs: asthma, bronchial catarrh, and pulmonary congestion; of the urinary organs: chronic cystitis, urethritis, gravel, and calculi. In addition to the foregoing, there is also the terrible haemophilia, now regarded as a result of gout; apoplexy due to rotten blood-vessels; and the cirrhotic, fibrotic, or gouty form of Bright's disease. In this extensive category might also be added eczema and various other forms of skin disease.

We thus see how compound and complex is the inheritance of gout in all its terrible totality! A typical case of gout, whether inherited or not, is easily recognised, and that it is generally hereditary is freely admitted; but when we see, as experience leads us to expect, severe digestive, nervous, cardiac, pulmonary, and genito-urinary symptoms developed in gouty subjects, we should regard them as revealing symptoms, and remember always that these, too, may be perpetuated hereditarily, either in similar or dissimilar forms, in accordance with the law of variability—one series of the phenomena of which is represented by the so-called metamorphoses in transmission. Taken either singly or together, all these symptoms reveal the gouty diathesis

which is strikingly hereditary, so that in their production heredity is always not only a potent, but an inevitable factor wherever they exist or may co-exist. No one who has ever suffered from gout is incapable, *cæteris paribus*, of transmitting a tendency to some of its protean forms to his children, and although in each case it may manifest itself differently, yet it should never be forgotten that heredity and variability are the two sources of the tissue proclivities which attest the inherited taint of gout in every case. Heredity, in fact, necessitates the transmission ; variability is accountable for the degree and variety of the inheritance.

Rheumatic gout, or rheumatoid arthritis, may be said to bear the same relation to gout as chronic articular rheumatism does to acute rheumatism or rheumatic fever ; although it may occur in persons who have never suffered from either gout or rheumatism, whilst generally presenting evidences of both, especially in its external characteristics. The pathology of rheumatoid arthritis is still a *quæstio vexata*. Dr. Fuller's views are as follows : "The disease should not be regarded as of a hybrid character, or, in other words, made up in part of rheumatism, in part of gout. It is my firm conviction that, just as true rheumatism and true gout do both manifest themselves at different periods of life in the same individual, so rheumatic gout may arise in a person who either has been, or may hereafter become, subject to true rheumatism, or true gout, and that it has no connection with either of these diseases, beyond that which attaches to it in virtue of its being a constitutional disorder, producing local manifestations in the joint." As Sir Alfred Garrod, however, naïvely remarks : "It is a much easier task to prove what rheumatoid arthritis is not than to give the slightest clue to what it is." Irrespective of its pathology, I am more

concerned with the hereditariness of a predisposition to it ; and although it must be admitted that the influence of heredity is less potent than in that of gout or rheumatism, yet I maintain that like all other constitutional conditions, however they may be modified in transmission, a predisposition to rheumatoid arthritis is transmissible, and this in the face of much opposition. Thus Garrod says : " Hereditary tendency does not appear to exert any very special influence ; for in looking over the histories of numerous cases, I fail to find much evidence of its action ; if it exists at all, it is much less powerful than in gout. We often find one member of a large family suffering severely from this disease, and the others entirely free from it." Now the great authority from whom I have just quoted does not deny that it is hereditary to some extent, but admits that the hereditary tendency is less powerful than in gout. I also admit this ; but until the question is settled as to why some morbid affections should be so much more strikingly hereditary than others, we must be content with the fact that such is the case, and rely entirely upon the light afforded by an ever-increasing experience. That experience warrants our belief in the hereditariness of rheumatoid arthritis is evidenced by the testimony of Professor Charcot, who, in forty-one cases, found a hereditary predisposition well marked in eleven. Moreover, Garrod strives to strengthen his negative testimony as to the hereditariness of this disease by instancing the fact of one member of a large family suffering severely from it, whilst the others remained free ! May I venture to ask if all the children of phthisical, scrofulous, or even gouty parents, have these predispositions transmitted to them in the identical forms, and in similar degrees, as those existing in the parents ? Surely not ; else,

indeed, should we be able to witness the realisation of the ideal law of heredity ! The fact is that variability or atavism, however mysteriously, pre-determines which children shall be affected, and in what degree, or whether, whilst they themselves may entirely escape, they may have the inherited predisposition enshrined within them, inoperative, ineffective, and inactive, so that they, in turn, may transmit it to their children, and their children's children. May I also ask, how came one member of the family, alluded to by Garrod, to be suffering from the disease ? Did he inherit or acquire it ? If the former, he will undoubtedly pass on a predisposition to it more or less ; if the latter, he may also transmit it, even in an aggravated form. Heredity works in larger cycles than we are apt to give it credit for ; for beyond the parents and their children are their ancestors and their descendants for many generations, and even as the past slumbers in each one of us, so do the sanitary welfare and happiness of our children's children in the future, for heredity governs all, and its force is never lost.

When alluding to the rachitic diathesis, in an earlier portion of these papers, I said that authorities were divided as to whether it was hereditary or not, also that the majority seemed to think that it was not. At the same time I admitted my belief that the general condition of the health of the mother had much to do with a predisposition to rickets in her children, provided her health was low and poor. To this opinion I still adhere, although time and circumstances impel me now to favour the views of those who regard rickets as hereditary whatever may be said as to the hereditariness of the diathesis. At least in numerous cases of rickets, hereditary influence has been a factor of great importance, especially manifesting itself in

a predisposition inherited more frequently from the mother than from the father; moreover, it has frequently been observed that when several families have resided under the same roof, and under similar circumstances, none of the children became rickety except those whose fathers or mothers had suffered from rickets during their childhood. Besides, as a further evidence of an inherited predisposition, numerous cases of foetal or congenital rickets have been observed under circumstances which negatived the possibility of any syphilitic or placental influence. As shewing metamorphoses in transmission, I may mention the fact that other constitutional diseases in the parents may contribute to the production of rickets in their offspring; thus Ritter von Rittershain alleges chronic tuberculosis in the father as a predisposing cause of some importance. Among the parents of seventy-six rickety children whose family history he investigated, he found seven tuberculous fathers and four tuberculous mothers. In the same way many facts are forthcoming to support the opinion that constitutional syphilis in the parents also predisposes to rickets in the children,<sup>1</sup> and thus heredity acts, mysteriously and potently with variability, acts and interacts, preserving and perpetuating the commonwealth of the community, as it preserves and perpetuates the characteristics of the race by varying and differentiating the individual.

Of the remaining diseases of the locomotive apparatus, I have still to refer to that very rare disease, osteo-malakia or mollities ossium, which has also been termed "rickets of the adult." Alluding to this, Mr. Hutchinson says—"Respecting a certain number of the best marked cases, there appears good reason to believe that the disease is really a form of

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<sup>1</sup> Senator.

rickets, and that the differences observed between the two maladies are chiefly due to the very different condition of the osseous system as regards its development at the time of attack." Facts are forthcoming which support this view; thus Rousseau records a case in which osteo-malakia attacked a woman of seventy, who had been rickety in childhood. Mr. Hutchinson also mentions a case (the skeleton of which is in the Brighton museum) where the man had lost two feet of his stature from innumerable fractures, faulty union, and the bending of his bones. The children of this man were much deformed by infantile rickets. As to the identity of osteo-malakia with rickets occurring at a later period of life, and the heredity of both, with regard to the former it should be remembered that the rachitic diathesis is dependent upon defective diet and absence of warmth and sunlight; that, as a general rule, it is only temporary, existing no longer as soon as the defective surroundings and diet are supplanted and neutralised by warm, dry, pure air, sunshine, and judicious dietetic treatment. Yet it is probable that in the few rare cases of mollities ossium which occur, it may have been reproduced, or developed *de novo*, under circumstances similar to those on which its primary production depended. Be this as it may, there is much in common in rickets and mollities ossium for which the rachitic diathesis satisfactorily accounts; and when we remember that both spring from and are perpetuated by constitutional conditions involving defective nutrition, we need have no hesitation, especially in the light of the affirmative evidence recorded, in regarding both affections as transmissible by heredity.

*General Disorders of Nutrition.*—The series of disorders which I now propose to consider may be regarded as entirely constitutional, and, therefore, all the more likely to

be hereditary. It must be admitted that there are different types of physiological constitutions manifested among various healthy individuals ; yet so elastic and indefinite are the characters by which these are distinguished, that every degree and variety of transitional forms are frequently manifested. In the same way, no hard and fast line of demarcation can be laid down as dividing purely physiological from pathological conditions, and as even health itself is an arbitrary relative condition, so physiological phenomena merge imperceptibly into those which are pathological. In this group of constitutional disorders “ the stability of the dynamic equilibrium of the vital processes is different from that which subsists in health—depends immediately upon the morbid change which the vital processes have undergone in regard to their force and direction, and is, therefore, ultimately bound up with the very essence of every constitutional disorder.” It is quite possible that an individual suffering from one or other of these nutritive disorders may for a long time appear in excellent health, until, in fact, some critical epoch, or external influence, or some intercurrent malady will develop the morbid tendency into a well-marked pathological condition. In the production of these, as in that of other, diseases or disorders, two sets of causes are usually recognised—viz., external or exciting, and internal or predisposing. Of the former we must be careful to exclude, in general terms, those of an infective or toxic character, from those denominated “ autogenetic,” which may be said to consist in some deficiency, unsuitableness, or excess of the normal vital stimuli, as light, air, warmth, food, exercise, etc.<sup>1</sup> Of the internal or predisposing causes, which influence the development of the general disorders of

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<sup>1</sup> Immermann.

nutrition, I may mention in the first place, as of most importance, inheritance; then age, sex, physiological constitution, errors of development and pathological processes, and psychical influences. Of these I am more concerned, on the present occasion, with inheritance, the influence of which is so emphatic and unmistakable as to often render all other possible causes as of no account. It should be remembered that hereditary constitutional maladies may be indiscriminately inherited from either parent, but that when both parents have the power of transmitting the same constitutional condition or anomaly, the transmission becomes almost absolutely certain. Heredity is the rule; non-heredity the exception. The exception may be illustrated by the following facts:—The influence of an affected parent may be neutralised or rendered dormant by that of the other one: by atavism or reverisional heredity a whole generation may be passed over, the inherited influence reappearing as potently as ever in the next: some members of a generation may be affected, others spared, owing to the influence of one parent being transmitted to certain members, whilst that of the other is transmitted to others, or that of fathers to sons, of mothers to daughters, or of fathers to daughters, and of mothers to sons. As Immermann says: “The parents need not always exhibit visible signs of their constitutional vice at the moment of conception: a general disorder of nutrition which is latent in them is as capable of being transmitted as one that is apparent. The inherited vice often remains latent in the infant, and does not show itself until a later period—till the age at which it showed itself in the parent. Hence, it follows that age as well as sex may favour or oppose the influence of heredity; that it is more correct to speak of the constitu-

tional vice itself, than of its manifestation, as being subject to inheritance." By the general law of heredity is therefore meant, that the most essential qualities of the parents are transmitted to their children, unless neutralised by other internal or external influences, and this law affects alike the domain of physiology and of pathology. Children resemble their parents, not however, "as stiff copies of equally rigid prototypes, but as variable magnitudes whose variations obey the same type." From this it will be seen that it is the entire physical life which is reproduced—the constitutions of the parents, with all their natural changes, which are generally transmitted: and so, even as a normal constitution is transmitted, is a constitutional vice repeated in the offspring.<sup>1</sup>

I shall now consider some of these general disorders of nutrition with regard to their inheritance.

*Anæmia*—Different persons have relatively unequal quantities of blood, and different persons are differentiated still further from each other by relative differences in the state of physical nutrition. Healthy constitutions may, therefore, be divided into those which are rich in blood or vigorous, and those which are spanæmic or feeble, according to these two sets of phenomena. When it is remembered that an individual constitution is the result of heredity, and the influences of his environment during foetal and extra-uterine existence, it will readily be conceded that certain forms or types of weakly, feeble constitutions, which so frequently develop pathological anæmia, are often inherited from either or both parents. The fact of whole families being characterised by a predisposition to anæmia in its many forms is proof enough. How

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<sup>1</sup> Ziemssen.

frequently is this the case ! And there cannot be a shadow of a doubt that whether we regard "the average power of renewing the constituents of the blood, the average rapidity with which they are utilised in nutrition and growth, and finally, the average amount of the blood store (as the resultant of the first two elements)," they are singly and collectively subject to the influence of heredity. The exciting causes of anæmia are numerous and important : but whether we regard the affection itself in its physiological or pathological aspect, we find in one as in the other almost invariably a predisposition which is inherited more or less, in differing degrees, and that the physiological predisposition will very readily become developed into the pathological.

*Chlorosis.*—To the influence of certain predisposing causes inherent in the patient's constitution we must trace the source of chlorosis ; and these are principally—sex, age, and heredity, which have the greatest share in its development. Sex and age are, in this affection, of pre-eminent importance, inasmuch as no combination of causes from which these are omitted are competent to develop it. In fact, youth and the female sex are indispensably necessary. With regard to age, chlorosis usually affects young girls between the ages of fourteen and twenty-four, during the time when sexual evolution occurs. Of no less importance, however, is the influence of heredity, as an inherited predisposition must be admitted to exist in many, if not the majority of cases. Moreover, the heredity of chlorosis may be taken as an example of certain inherited affections which usually manifest themselves at the same period of life at which they affected parents or ancestors, and which have been explained on the hypothesis of latent characteristics contained in the individual in the germ state, and which

come to light only under definite conditions, and at some particular point of her or his development, and this particular moment corresponding with a similar moment in the progenitors. Hereditary diseases are, in fact, good instances of heredity at corresponding periods. Thus chorea, which usually makes its appearance in childhood, chlorosis in youth, consumption in middle age, gout in old age, are naturally hereditary at the same periods. With regard to the inherited tendency to chlorosis, the disease is often found breaking out in the majority of, or in all, the female members of a family from one generation to another, oft repeated, and at corresponding periods of life, and this independent of the external circumstances amid which they may have been brought up. Previous to the development of the chlorotic attack, predisposed girls have usually manifested anaemia, and functional irritability of the nervous system, but not invariably, as the attacks have been known to occur unexpectedly in seemingly robust and healthy girls. In whatever way produced, however, and under whatever circumstances, there is in the generality of, if not in all cases, a predisposition which is potently and emphatically hereditary.

*Progressive Pernicious Anaemia.*—I only allude to this rare and mysterious affection in order to make the list of affections now under discussion as complete as possible. Unfortunately, so little is known as to the etiology or pathology of this morbid condition that I am unable to furnish any evidence as to whether it can be said to be hereditary or not. Closely allied *in kind* to ordinary idiopathic or symptomatic anaemia and severe chlorosis, it yet differs materially from either in degree, and is characterised by the so-called “anaemic fever” of Biermer, which,

*cæteris paribus*, may be regarded as, to some extent, pathognomonic. Frequently associated with pregnancy, this almost invariably fatal condition sometimes occurs as a complication during ordinary anæmia, but the causes of such complication are completely unknown—as, indeed, is almost everything concerning either its etiology or pathology. At the same time, as it is closely allied to anæmia and chlorosis—which, as we have seen, are both hereditary—I cannot abandon the idea that in some cases, at least, there is an hereditary element in its production; there can, at any rate, be no effect without a cause, and as the causes of disease are either inherited or acquired, I shall at least maintain the hypothesis of heredity, until it can be proved that this mysterious condition is dependent entirely upon external circumstances for its causation.

*Corpulence or Obesity*.—It must be admitted that a predisposition to this condition is generally either inherited or congenital, and this despite all other causes that can be assigned. Those who are predisposed will become fat under any circumstances, and in any rank or condition of life. Like most hereditary constitutional anomalies, its transmission consists in a tendency only, and it may also be included amongst those affections which occur at corresponding periods of life. Thus it may occur during infancy, or not until the fortieth year or thereabouts, and later. It has not yet been determined whether sex has any influence on the hereditariness of this affection, or whether the male or female parent has most to do with the transmission of the tendency. It is more than probable, however, that the predisposition more frequently descends from and to the same sex—viz., from father to son, and from mother to daughter.

Immermann, in discussing the peculiarities of constitution upon which the inherited corpulence can depend, enumerates

the following—viz., hereditary differences in the rapidity of blood formation, dependent upon the new growth of red corpuscles; hereditary differences in the trophic and plastic energy of the other tissues of the body; and hereditary differences in the quantity, function, and proliferating capacity of the fat-carrying connective tissue and its vascular apparatus. The foregoing are some of the conditions which on the one hand influence the extent of the tendency to fat-production; and, on the other hand, possibly or certainly, come under the influence of the hereditary principle. Thus far Immermann analyses the constitutional peculiarities on which, in a pathological sense, corpulence depends; but it will be seen that they are all hereditary, and this is the main point for which I am contending. There cannot, indeed, be any doubt that obesity is a condition, a tendency to which is unquestionably hereditary, and that it characterises families for successive generations *malgré* many systems of treatment and innumerable nostrums, notwithstanding which *natura non nisi parendo vincitur*.

*Scrofulosis*.—However great the temptation, I have no intention of entering here into a discussion of the innumerable theories propounded from time to time as to the etiology and pathology of scrofula, and its relation to tuberculosis, but shall content myself by observing, in the words of Dr. H. G. Sutton, that “A strumous constitution produces phthisis; scrofula and phthisis are inseparable.” Regarding tuberculosis or scrofulosis as a constitutional disease, it is now universally acknowledged to be hereditary in its origin. Pathologists are divided in their opinions as to whether the disease itself, or a predisposition to it, is inherited; and, notwithstanding the fact that tubercle is often actually congenital, I am inclined to believe, with

Niemeyer and his school, that as a rule, only a constitutional debility is transmitted, with a tendency to low forms of inflammation, the products of which rapidly become caseous, and thus lead to tubercle. My own opinion is that a pre-existing condition of scrofula is, in the majority of cases, necessary for the development of tubercle, although what is recognised as scrofulous does not always attain a distinctly tubercular condition. In tubercular as in scrofulous cases, there will usually be found a predisposing as well as an exciting cause—the former being hereditary, the latter acquired; and the higher the degree of hereditary predisposition, the less need there will be for an exciting cause.

Following closely the definitions of Virchow and Billroth, Birch-Hirschfield thus defines scrofulosis:—A constitutional anomaly which shows itself by changes, partly of an inflammatory, partly of a hyperplastic nature, excited in the tissues by a comparatively slight noxious influence—changes which are endowed with insufficient recuperative power, and are therefore prone to lapse into regressive metamorphosis, and following thereupon, into local tuberculosis. Virchow ascribes scrofulosis to “a certain weakness or incompleteness in the structure of the lymphatic glandular apparatus,” and accepting this theory as far as it goes, we should remember that pathology furnishes us with many proofs as to the dependence of weakness of certain systems and organs on an hereditary predisposition. Thus haemophilia furnishes an example of inherited weakness in the circulatory apparatus. Many other instances might be mentioned.

Of the causes which give rise to scrofulous constitutions—apart from anatomical and physiological conditions, concerning which nothing is definitely settled—the most important,

and that most materially supported by experience, is hereditary transmission. Undoubtedly various forms of scrofulous as of tubercular disease run in families. Every practitioner must be cognisant of the fact that the parents of scrofulous children were themselves, in many instances, also scrofulous in their early age, and that phthisical parents very frequently generate scrofulous children. Although statistics may not count for much, yet Lebert was able to prove hereditary transmission in one-third of eighty-eight cases. Balman ascertained that among 141 scrofulous patients nine had lost the father, and eleven the mother, of tuberculosis; while thirty cases of tuberculosis had occurred in near or distant relatives of the rest.<sup>1</sup> It must therefore be conceded that from first to last, amid all its sources and varieties, amid all its developments and retrogressions, in whatever form it may assume, amid all its degrees and complications, heredity is the prime factor in the production of scrofulosis, as it is also in tuberculosis.

*Diabetes Mellitus.*—But a few decades ago, anyone who would have ventured to include heredity as a predisposing cause of this affection would have probably been treated with ridicule. Since, however, greater attention has been directed to the matter in more recent times, the result of constantly accumulating experience is undoubted and increasing testimony in regard to the hereditary character of diabetes. Not only have several of the brothers and sisters in certain families become diabetic, but instances are recorded where every child has been the subject of this disease. Moreover, it has been frequently observed that parents, or grand-parents, suffering from the disease, have transmitted a predisposition to their children and grand-

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<sup>1</sup> Ziemssen.

children respectively; nay, more, cases have frequently occurred even among the collateral and more distant relatives of diabetics. I feel assured that time and increased experience are alone wanting to substantiate the views held in the foregoing pages as to the influence of heredity in the production and development of morbid conditions generally, and for the reasons assigned—viz., that the inheritance of physiological and psychological peculiarities necessitates the inheritance of those which are pathological.

Epilepsy, mental affections, and other diseases of the nervous system are often intimately associated with diabetes, and this connection is also, in almost every case, due to hereditary predisposition. Cases showing the co-existence of epilepsy, melancholia, etc., are recorded by Seegen, Zimmer, Schmitz, and other authorities. Among the near blood relations of a diabetic patient Langiewicz found epilepsy in seven. One of Griesinger's patients had had epileptic seizures in childhood, and all the brothers and sisters had suffered, or were suffering in the same way. A case is recorded by Lockhart Clarke, in Beale's *Archives of Medicine*, in which diabetes occurred in an epileptic who died of cerebral softening.

As to the heredity of diabetes itself, many cases are recorded by P. Frank, Blumenbach, Brisbane, Prout, Pavy, Dickinson, and Senator, and Marsh records the case of a family in which the disease was transmitted even to the fourth generation. From 1868 to 1874, R. Schmitz was enabled to positively affirm the influence of heredity in 22 out of 104 cases.<sup>1</sup>

*Diabetes Insipidus* is also undoubtedly hereditary, and like the mellitic affection is frequently associated with the neuro-

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<sup>1</sup> Senator.

pathic predisposition. An hereditary association has also been observed between the insipid and mellitic variety. Thus Troussseau, Reith, and Seegen report cases in which the grandfather had the mellitic and the granddaughter the insipid form; a father and son had the mellitic and a daughter the insipid form, and a son had diabetes mellitus whose father had suffered from diabetes insipidus. The most remarkable instance of hereditary predisposition is that recorded by Lacombe, in which, out of one family a mother, three sons, and a daughter were attacked by the insipid form of diabetes, besides the brother of the mother and his children. Other interesting and less startling cases are reported by Lancereaux, Deebrey, Reith, Desgranges, and Addinel Hewson.

Having thus glanced rapidly at the principal general disorders of nutrition, it will be seen that heredity has a large share in their production; and although in some instances the testimony recorded may be less satisfactory than in others, yet I firmly believe that in the future, and probably before long, increased experience will not only attest the views I have enunciated, but will throw the light of science over that which may now appear be be vague and hypothetical.

*Acute Infectious Diseases.*—These are now generally classified as follows—viz., I. *Contagious* : including measles, scarlet fever, variola, vaccinia, typhus, diphtheria, glanders, malignant pustule, rabies, virulent ulcers and blennorrhœas, syphilis, pyæmia, puerperal fever, and erysipelas ; II. *Malarial* or *Miasmatic* : including simple intermittent, remittent, and continued malarial fevers, etc.; III. *Miasmatic Contagious* diseases : as cholera, typhoid, dysentery, yellow fever, plague, influenza, hay fever, miliary and Dengue fevers, and

epidemic cerebro-spinal meningitis. Are these, or any of them, subject to the influence of heredity? Before attempting to answer this question, I may be permitted to mention the now generally-believed doctrine that the acute infectious diseases are dependent for their production upon a *contagium* or *miasma vivum*; in other words, upon specific germs which have the power of reproducing themselves to an unlimited extent, the specificity of which consists in the fact that a given form or kind of disease is invariably, absolutely, and under all circumstances, due to a given kind of morbid germ, as cause or agent. We thus see that—at any rate, in the majority of the acute infectious diseases—the body remains passive to the action of germs, virus, or poison intruded from without; and that the autochthonous origin or spontaneous generation of the *contagium vivum* is no longer generally recognised or admitted. When we therefore regard the fact that any of these specific germs or poisons may so disturb the health of an infected individual as to not only cause him intense suffering, but to jeopardise his life; that after a longer or shorter time these effects may cease completely, and, beyond the life-long immunity from the influence of the same poison thus produced, the body may be otherwise unmodified, we cannot expect to find much evidence of the influence of heredity, especially as even the immunity of the individual cannot be transmitted to any great extent. Doubtless, these specific fevers, or, at least, some of them—as, for example, measles and small-pox—may occasionally aggravate a pre-existing diathesis as the tubercular or scrofulous, or may produce ephemeral dyscratic conditions of health; but as a rule, after the cessation of the specific exanthem or fever, the bodily organs and functions may remain unaffected, so that beyond the passing

effects of a more or less sharp specific attack, the physical and mental condition of the individual may return to their original state. Not always, however, is even the immunity of the individual from modified, or even full-developed secondary attacks, complete, as either may recur repeatedly, so that it may be safely said that no heritable condition of health is ever produced.<sup>1</sup>

Having thus far stated the case against heredity, I may now be permitted to ask—how is it, as frequently happens, that these specific germs or poisons manifest such a selective capacity that they may attack only one or two individuals in a family, and leave the others unaffected? How frequently this happens is well known to every practitioner. While it is quite true that a low physical condition induced by intemperance, bad feeding, chronic disease, over-crowding, want of cleanliness, mental depression or fear, very often predisposes individuals to succumb to an attack of some of the acute infectious diseases, it must not be forgotten that there are individuals in most families who, owing to some constitutional peculiarities, are insusceptible of being influenced by some of them, while yet other individuals are insusceptible to the influence of other specific poisons. At the same time it should be stated that insusceptible individuals may sometimes act as media for the dissemination of some of the exanthemata if allowed to pass from the sick room, and to mingle with healthy persons. There is, in fact, not one of these acute infectious diseases to which many individuals are not more or less insusceptible; and I contend that where this insusceptibility has not been acquired by an attack of some of the acute infectious fevers, it must have been inherited as a constitutional peculiarity, although we cannot

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<sup>1</sup> Mr. Jonathan Hutchinson.

tell in what this peculiarity consists. In other words, some individuals are predisposed to the acute infectious fevers, whilst others are not ; and as this predisposition cannot, so far as I know, be acquired—as the specific fevers are incapable of originating pathological habit by their repetition in the same individual, and therefore are incompetent to produce anything in the nature of a permanent diathetic condition—it must be inherited as a constitutional peculiarity. We thus see that while the specific fevers, in their influence upon those affected by them, leave no taint that may be transmitted, and that so far as the majority of the exanthemata are concerned, one severe attack of either of them confers an immunity (which may be life-long) from secondary attacks ; yet the fact remains that in almost every family there are those who are either especially predisposed, or more or less insusceptible to their influence, and that whilst such predisposition consists in an unknown constitutional peculiarity, it is only fair to assume that it has been produced by heredity. Moreover, unless the insusceptibility has resulted from the immunity bestowed by a former attack, and has thus been acquired, it may also be regarded as a constitutional peculiarity which has been inherited.

I have said just now that one attack of an exanthem may confer an immunity from secondary attacks which may last during the life-time of the individual, but even this immunity is often seen to be neither perfect nor universal ; for there is not one of the exanthemata which may not attack the same individual more than once, although a first attack so modifies those which are secondary as to render the symptoms, as a rule, much less severe, and comparatively immature. In the case of vaccination, for example, it is a well-known fact that while some persons lose its protective

influence much sooner than others, there are others who are insusceptible to the vaccine virus altogether. So much for the exanthemata.

Of those acute infectious diseases which are not due to specific animal poisons I may instance erysipelas and diphtheria, to both of which, whilst most persons are subject to their influence, some are peculiarly susceptible, and the susceptibility is such that it persists throughout life, and is unquestionably hereditary. "In both," as Mr. Hutchinson says, "that with which we have to deal is a personal and inherited peculiarity, giving proclivity when certain exciting causes are brought to bear, to peculiar forms of inflammatory action." There can be no doubt that the difference between the states of health produced by the specific poisons, and those which are due to inflammation from non-specific causes, are strongly and well marked, the latter coming under the law of intensification by habit. The same authority says: In the development of such inflammations as those of erysipelas, diphtheria, elephantiasis, and especially when not due to contagion, the constitution of the individual takes a large share, and the mere fact of their occurrence reveals his previous proclivity. The disease originates in part from without, but in part also from within. It is not an instance of intrusion, but of development, and the peculiarities of blood, tissue, or nervous system, are exactly those which are capable of increase.

It is, indeed, beyond question that amongst the causes of erysipelas and diphtheria, family and individual susceptibility must be regarded as factors of prime importance. It would be easy to cite cases in defence of this assertion, but as the fact is too well known to be denied, I shall content myself by the mere statement of it.

Of the remaining infectious diseases which are also purely contagious I have yet to consider glanders, malignant pustule, rabies, virulent ulcers and blennorrhœas, pyæmia, and puerperal fever ; these, however, being all caused by external poisons introduced into the system, need not detain me here, as heredity can have nothing to do with them beyond the fact that the system into which they are introduced may have an inherited constitutional peculiarity which will predispose to their influence. Indeed, of this there can be no doubt, as none of them can germinate without a suitable soil, and in the case of each one of these affections, many individuals seem to be especially predisposed, while others show comparative immunity. I may now briefly sum up the results of our inquiry as to whether the acute infectious diseases are subject to heredity, and if so, to what extent. I have asserted that so far at least as the exanthemata are concerned, the mental and physical condition of affected individuals may remain unaltered, after the attack has subsided. Their tissues, however, will be so far altered as to be able in all probability to withstand a second attack of the same poison during their lives. This immunity, however, is probably seldom complete, and never universal. Thus these affections leave no taint to be transmitted. On the other hand a predisposition, or insusceptibility, is very frequently manifested by those exposed to the influence of these specific poisons, and here heredity has been a most important agent, with the exception of those cases in which a predisposition may have been acquired by repeated attacks (as in the case of erysipelas and diphtheria), or in which insusceptibility represents the immunity resulting from a first attack.

Although a chronic, and not an acute infectious disease, I may here allude to syphilis, as it is so markedly contagious ;

and with regard to this affection, which has been denominated the most chronic and most persistent of all specific fevers, it may be remembered that I did not include it in my classification of the diatheses, and I may now be permitted to give my reason. It may, indeed, be inferred from what I have already said as to the non-transmissibility of any of the effects of the specific fevers, and that this holds good also in the case of syphilis, I think I shall be able to show. Diathesis has been defined as "any condition of prolonged peculiarity of health giving proclivity to definite forms of disease;" and referring this definition to syphilis, to which there is no physical proclivity, we see that syphilis is more clearly a matter of dyscrasia than of diathesis. Moreover, as in the other specific fevers, there is no actual transmission of any diathetic peculiarity, as, in the words of Mr. Hutchinson, "it is not the diathesis which results from the disease, but *the germs of the disease itself—the particulate elements of the virus—which are transmitted*. It is transference, a form of contagion rather than hereditary transmission, which occurs. . . . It is far more like contamination *in utero* than true inheritance. By contamination, in this use of the word, I mean that with sperm or germ (of either or of both parents) there passes the virus itself, the sperm or germ being itself unmodified, but simply the material medium of transference. In the case of the mother we know well that it is not necessary that the germ should have been infected at all, but that if her blood receives the virus, even so late as the eighth month, it will pass into that of the child also. Inherited syphilis, when produced under these last-mentioned circumstances, runs exactly the same course as when derived from a parental taint which existed before conception. A child, then, I assert, inherits syphilis in precisely the same sense,

and in precisely the same manner, as it may inherit small-pox. It inherits not the diathesis, but the disease. The reason why the inheritance of small-pox is very rare, whilst that of syphilis is, unfortunately, common, is simply that the period during which the virus is extant in the blood is very different in the two cases. . . . . My argument, if I have made it plain, has pointed to the conclusion that no minified transmission of syphilis is possible ; that the child gets either nothing at all, or the germs of the disease, and that in the latter case they will, subject to the laws of idiosyncrasy, develop equally in all cases." Whilst, therefore, regarding the inheritance of syphilis as an illustration of actual transference of the germs of the disease, rather than transmission of any diathetic peculiarities, it will be thus seen that for this reason I regarded the syphilitic condition as one of dyscrasia rather than of diathesis, and I thus purposely omitted it from my classification of the latter. I therefore regard syphilis, like the other specific fevers, as incapable to any great extent of transmitting in the true sense any of its effects. It is questionable whether the syphilitic virus itself is capable of modification, and we must attribute the differences in its results in different individuals to physical peculiarities in the individuals themselves, some of which may have been acquired and others inherited.

I have now to consider a group of infectious diseases which are non-contagious, and which, depending upon *malaria* as their cause, are therefore purely miasmatic. This group includes simple intermittent and masked fevers, pernicious fevers, remittent and continued malarial fevers, and malarial cachexia or chronic malarial infection. These differ from the contagious specific fevers in the following particulars.

I. "Contagia are reproduced in and given off from the system ; malaria is not."

II. "Malarial fevers are not communicable from the sick to the healthy."

III. "Malarial fevers have an intermitting indefinite course, and an irregular period of duration."

IV. "An attack of malarial fever confers no immunity from a second."<sup>1</sup>

Inasmuch as each of these varieties of malarial infection depends upon the intrusion of a poison from without, it is not necessary for me to consider any of them in any detail. In the foregoing pages (when treating of the diatheses) I alluded to the nature of the malarial poison, and need therefore do no more than confine myself to the consideration of how far malarial affections in general are subject to the law of heredity. The diathesis due to malaria might almost be regarded as universal, as few, if any, of us may be quite exempt from its effects, however remote, inasmuch as from the earliest times the entire human family has been brought under its influence. This diathesis is also hereditary, the amount of inheritance being proportionate to the intensity and duration of the affection in the parents or ancestor. If we remember that the subject of malaria "will display through life peculiar susceptibilities," and that these effects are invariably permanent, "it is easy to see that a poison so persistent in its action and of which the effects, even in mild cases, are so well-nigh permanent, must be capable of producing that state of body which we call diathesis. The malarial diathesis is, indeed, a well-marked one, and it exists in greater or less degree in all who have ever come under the influence of its cause."<sup>2</sup> Thus in the pedigree of these

<sup>1</sup> Maclagan.

<sup>2</sup> Mr. Hutchinson.

malarial affections we read of their long descent, as time alone could have rendered the human race so subject to them, and, as a matter of fact, their history, of every type, reaches back to the earliest period of medical knowledge. Whilst we are all probably more or less subject to the malarial diathesis, it should not be forgotten that all are not in equal measure predisposed to the action of the malarial poison, for it is well-known that "during the endemic prevalence of malaria, only a certain number of persons are attacked by it, the majority remaining exempt, although subject to the same telluric and climatic influences;"<sup>1</sup> and this exemption is, in all probability, very frequently inherited. That constitutional varieties are not to be ignored as influencing the liability to malaria is proved by the fact that weak and anaemic persons are especially prone to be attacked, and, according to Griesinger, marked differences in the character of the disease may sometimes be recognised, according as it occurs in subjects of a plethoric, or of an anaemic constitution. As malaria can alone produce malarial diseases, their different forms differ relatively only in degree, the poison itself being subject to variations in quality and quantity. These affections may, therefore, be progressively arranged from the simplest to the severest forms as follows : 1. Quartan intermittent ; 2. Tertian ; 3. The masked intermittent ; 4. Double tertian ; 5. Remittent ; 6. The continued ; and 7. The pernicious fever ; the various grades being proportioned to the intensity of the poison. But the real fact to remember is that all these varying forms are due to the effect of the malarial poison on different individuals, and that these individual differences may be either acquired or inherited, and that even when acquired many of them may be transmissible.

I may now summarise the evidence as to the influence of heredity on these malarial diseases as follows:—The real nature of the potential causative agent, malaria, is unknown: obviously, however, it is communicated to the system from without. Its effects differ in different individuals, but as they have been known to exist from the most primitive times, so they have become so inbred into the human race that comparatively few of us are totally exempt. Thus a diathesis has been developed which might almost be included with those termed “universal”—viz., the catarrhal, the rheumatic, and the scrofulous. Moreover, in addition to this racial peculiarity, many individuals are especially predisposed to the influence of malaria by heredity, and this can all the more easily be understood when we remember that each individual who has suffered from malaria has his tissues branded with it during his life; and the probability is that with the amount of diathetic peculiarity which he has—in common with most— inherited, he will also transmit a thus intensified personal predisposition to his children. Given an individual who has suffered severely from any variety of malarial disease, he must in the first instance have himself been specially predisposed before being attacked, and if the law of heredity holds good at all, it assuredly follows that, *cæteris paribus*, he may transmit this predisposition, if not the actual disease, to his offspring.

I have still, however, to consider the third division of the acute infectious diseases—viz., those which may be said to be *miasmatic-contagious*, which, as they cannot be conveyed from diseased to healthy individuals by mere contact, are not contagious according to the significance of the term, and on the other hand, the poison has the characteristic peculiarity of the miasmatic diseases in being, in the first

instance, drawn from an external source ; but, differing from them in the fact that "the poison only originates outside the body when an affected body has furnished the germs." This division includes typhoid fever, cholera, dysentery, yellow fever, the plague, dengue, miliary fever, influenza, hay fever, epidemic cerebro-spinal meningitis, and, perhaps whooping cough ; and the mode of extension of these diseases is so far understood as to enable us to state with certainty that they can neither be reckoned among the contagious nor among the miasmatic diseases according to the following definition : *Contagium* has been defined as a specific excitant of disease, which originates in the organism suffering from the specific disease ; while *miasm*, on the other hand, is the term used to denominate a specific excitant of disease, which propagates itself outside of, and disconnected from, a previously diseased organism. *Contagium* can be conveyed by contact from a diseased person to a sound one, produce the disease in him, and then again reproduce itself. *Miasm* originates from without ; taken up into the body, it can call a specific disease into action, but it cannot spread the disease any further by conveying it from a diseased to a sound person.<sup>1</sup> Seeing then that the diseases just enumerated are neither contagious nor miasmatic according to the above definition, while possessing some of the characteristics of both, it seems but right to include them in a third group, to which the name *miasmatic-contagious* has been given, which, moreover, they have held for a considerable period, though usually in another sense. As in the two previous divisions, and for similar reasons, we can trace no potential causative agency to the influence of heredity in this one, apart from the fact that the protophytic fungi, some

<sup>1</sup> Liebermeister.

of which have been identified as the *fons et origo mali* of other diseases, are so far influenced by heredity as to always propagate themselves after their kind, each preserving its own characteristic individuality, so that, as Tyndall observes, from their respective viruses you may plant scarlet fever, typhoid fever, small pox, *et hoc genus omne*; that as surely as a thistle rises from a thistle seed, as surely as the fig comes from the fig, the grape from the grape, the thorn from the thorn, so surely does the typhoid virus increase and multiply into typhoid fever, and nothing else; the scarlatina virus into scarlatina, and into nothing else; the small-pox virus into small-pox, and nothing else; so that to all intents and purposes a virus may be regarded as a seed which invariably generates after its own kind. And here we see the all-pervading influence of heredity that necessitates its recognition as an universal law, for as in the highest forms of organic life, from man himself down through the lower animals, until we reach the lowest forms of all, there heredity manifests itself in the reproduction of each after its kind.

As in the two other groups of acute infectious diseases, we find heredity acting similarly in this division—viz., with regard to predisposition and insusceptibility. It may, indeed, be asserted as an axiom that individual predisposition plays an important rôle not only in all epidemics, but in all cases, and it may also be stated that this predisposition, while differing in development in different individuals, is, if not more, at least equally, as potent as all predisposing causes of an external character. Let me take cholera as an illustration. It is a well-known fact that many persons enjoy at least a temporary immunity against the disease. During an epidemic of cholera, should choleraic diarrhoea prevail, many escape it entirely, others suffer only lightly and temporarily, while

others again, notwithstanding the employment of all sorts of therapeutical and hygienic measures, are subject to continued and repeated attacks (Lebert). Thus, again, with typhoid fever, the poison of which, as established by Budd, is propagated continuously, and never originates autochthonously, and which can only germinate in a suitable soil. Such disease germs pass into each one of us every day of our lives ; why, then, do they not manifest their specific effects ? And why, even when they do germinate, does the product vary ? Because, in the first instance, they must become implanted in a suitable soil, or they produce no effect, and secondly, because when they do germinate the product varies with the soil. Thus while some may be peculiarly predisposed to the action of some of those specific germs, others will be found more or less insusceptible, and that this predisposition or insusceptibility frequently amounts to a constitutional peculiarity, in the production of which heredity has had a share, it is only fair to assume. As regards the differentiation of individuals in relation to the respective tissue-peculiarities which they have inherited and acquired, I cannot do better than again quote the words of Sir James Paget, who says : "This living soil is in each as personal and distinct as any other constituent of personal character, and the study of it must be intimately personal, with an exact analysis of every disposition to disease." How this predisposition or insusceptibility is produced, or in what it consists we do not know ; we can only accept the facts ; but giving full force to every possible factor of an external kind, and, in the cases of insusceptibility, to the comparative immunity produced by previous or primary attacks, there still remains a far greater amount of evidence as to the efficacy of individual predisposition and insuscepti-

bility, the result of breeding, and, therefore, of inheritance. By this I do not mean that the parents or ancestors must necessarily have undergone attacks of acute infectious diseases, or that they possessed a similar predisposition or insusceptibility towards them, but that *somewhat* these predispositions and insusceptibilities have appeared as constitutional peculiarities, and that they have constituted a life-heritage just as much as any other constitutional peculiarity which they may have obviously inherited.

Heredity preserves the race by varying the individual, and the law of variability, known only by its effects, is responsible for this individual differentiation; but how these effects are produced we cannot tell, for "as one star differeth from another," so does every individual, not only in what he acquires, but still more in what he inherits, and further we cannot go. It is therefore unnecessary that I should go into any detail in considering the remaining affections in this group—viz., dysentery, yellow fever, the plague, dengue, miliary fever, influenza, hay fever, (undoubtedly hereditary), epidemic cerebro-spinal meningitis, and whooping-cough. That they are all produced by external causes introduced into the system is an admitted fact, but that, in relation to each one of them, some individuals are particularly predisposed, while others are comparatively insusceptible must also be admitted. That both this predisposition and insusceptibility may be inherited, *i.e.*, the result of inheritance, using the term in its broadest signification, admits but of little doubt, and this is all I contend for. For although the effects of the acute specific or infectious diseases leave no trace in the affected tissues that can be transmitted to any extent, yet it must be conceded that far beyond the agency of external circumstances, and the relative immunity pro-

duced by primary attacks, these predispositions and insusceptibilities often amount to constitutional peculiarities in which, somehow, heredity must have had a share in producing. If they appear to be the result of variability, it must be remembered that variability is necessitated by evolution, and without heredity, evolution, nay, life and variation are impossible ; for “ evolution produces physiological and psychological modifications ; habit fixes them in the individual, heredity fixes them in the race ;” so that heredity and variability act and interact inseparably through the universal kingdom of organic life and being. Thus alike in races, families, and individuals, does heredity assert itself, and thus are races, families, and individuals, preserved and perpetuated, differentiated and destroyed by heredity and variability, and as in health, so likewise in disease.

I have still, however, to consider the *diseases of the organs of special sense*, and also those of *the skin*. To some of the former I have already alluded in an earlier portion of these papers, when discussing the heredity of sensorial qualities, but as this allusion was from the psychological stand-point, I may now be permitted to refer more particularly to the same, only from a pathological point of view. I then showed that besides those varieties of vision depending upon mechanical causes, those also depending upon anæsthesia or hyperæsthesia of the nervous element were all hereditarily transmissible. Of those dependent upon mechanical causes, strabismus, myopia, and presbyopia are the most common, and these are all markedly hereditary. Portal describes the Montmorency sight—an imperfect form of strabismus which distinguished nearly all the members of that family. Stahl also relates the following remarkable case :—A soldier lost in war one of his eyes. He returned

to his country and married ; his wife bore him a son, one of whose eyes was quite dried up, so that he was monoculous like his father ! Congenital blindness may run in families, and blind persons will sometimes beget blind children. A blind beggar was the father of four sons and a daughter, all blind. Dufau, in his work on blindness, cites the cases of twenty-one persons blind from birth, or soon after, whose ancestors—father, mother, grandparents, and uncles—had some serious affection of the eyes.<sup>1</sup> While amaurosis, nyctalopia, and cataract in the parents may become blindness in the children, they are each transmissible, and amaurosis, although not perhaps so frequently transmitted as the other two affections, is yet by no means unknown. Cataract is very frequently inherited, and Carus quotes from Lusardi a case where the children of a man who suffered from cataract were all born with this disease. A remarkable case of inherited nyctalopia, which has been strictly investigated from official documents, and described by Cunier in a pamphlet, may here be quoted. It is shown in this little work that nyctalopia had been propagated during centuries in the same family, from one generation to another, and that of 600 descendants of one ancestor, a great number were afflicted with this evil, so that the same is spread over Vendemian and some other neighbouring places through this family alone. There exists no example of the evil ever having befallen a member of this family where both parents were free of it ; whenever a child was afflicted with it, then surely either his father or his mother had had the same complaint. It is further proved that the complaint was, in the greater number of cases, inherited from the father.<sup>2</sup>

<sup>1</sup> Ribot.<sup>2</sup> Steinau.

In addition to those affections of the visual apparatus depending upon mechanical causes, and those abnormalities of vision, whether of the nature of anæsthesia or hyperæsthesia—and which are all, in every degree, hereditary—there can be no doubt that the majority of cases involving the eyelids are also hereditarily transmissible, or at least that a predisposition to them is very frequently transmitted from parents to children. To this latter class belong epicanthus, ptosis, entropion, ectropion, trichiasis, hordeolum, ophthalmia tarsi, cysts, warts, and nævi. There is, in fact, no form of ocular abnormality, whether visual or palpebral, which may not be inherited, or to which a predisposition may not be transmitted.

With regard to morbid affections of the ear, as in the case of the eye, they may consist of either anæsthetic or hyperæsthetic peculiarities, and these may be equally transmitted. I have already discussed the heredity of deaf-muteness, and would here only remark that it should be remembered that in those cases in which deaf-muteness is not inherited, it may be transformed into an infirmity of some other kind, as hardness of hearing, obtuseness of the mental faculties, or even idiocy (Ribot). How these transformations occur I have already alluded to in previous pages; moreover, in those cases of musical talent where "a good ear" is essential, the musical aptness necessarily depends upon the heredity of certain qualities of hearing. Of those affections of the ear which are perhaps most frequently inherited, I may mention cophosis nervosa. My accomplished friend, Dr. Macnaughton Jones, who is generally considered an authority on every subject upon which he writes, says, in the last edition of his excellent *Practitioner's Handbook of the Diseases of the Ear and Naso-pharynx*—"That deafness is

one of those ailments which nature entails as a hereditary reminder of parental imperfection is well known, and in it frequently we have a good exemplification of the law of atavism ; the defect appears to skip one generation and to re-appear in the next. I have just at present a lady under my care who is very deaf, and whose mind is beginning to fail ; she is one of a family two other members of which are deaf. Deafness has been transmitted for generations, and, coincident with the deafness, there is also a family history of insanity.

Occasionally, though we cannot find evidence of deafness in the parents, curiously enough two or three brothers or sisters are affected. The deafness at other times will be found on the father's or mother's side, while the parents have escaped. Such hereditary deafness is nearly always of a most unfavourable type, and treatment generally ends in a negative result. In a great many cases the physician does not see the patient until the deafness is far advanced and there is evidence of serious middle and internal ear trouble. . . . It is a fact, and a most vital one in regard to this form of deafness, that we frequently find it first make its appearance after puberty, or even later on." Thus, hearing, of every form and variety, whether of the nature of anaesthesia or hyperæsthesia, may have an element of heredity in its production, which may have become decreased, intensified, or otherwise modified, in its descent from one generation to another.

With regard to heritable peculiarities of touch, I have already referred to them when discussing the heredity of the sensorial qualities. There can be no doubt that parents transmit to their children the most singular perfections and imperfections of touch ; and all these tactile sensations, as

hardness, softness, elasticity, etc., and sensations of temperature, as of heat and cold, are alike subject to, and governed by, the law of heredity. The relative sensibility of different families to tickling is well known ; in fact, every form of anaesthesia or hyperaesthesia of the skin is markedly hereditary. All this, however, is more physiological than pathological ; but with regard to the latter I may mention cases related by Lucas, which illustrate how the sense of touch, when exaggerated or neutralised, may affect pathological conditions, and how abnormal sensitiveness to heat or cold may be transmitted. A woman whose tactile sensibility was so exalted that for her the slightest hurt was an agony, married a man endowed in the highest degree with the opposite quality. He did not lack intelligence, but his heart and his skin were impassable. A daughter was born to them, and she is as insensible to external pain as her father himself. We have seen her endure, without complaint, and even without appearing to notice it, pain which would have been very acute for ourselves.

A family from the south, says the same author, who was acquainted with the persons, came to Paris some time ago. Several of the children were born in Paris ; but those born there, as well as those brought there from the south, were in childhood extremely sensitive to cold. One of the daughters married a man from the north, who is insensible to cold, provided it is not excessive. The child born of this union is more sensitive to cold than even its mother ; like her, he shivers at the slightest fall of temperature, and so soon as the air becomes cold, he is afraid of leaving the house. The insurmountable repulsion which some persons have for touching certain objects : as silk, velvet, mother-of-pearl, cork, peaches, etc., is well-known, and cases might easily be

cited showing how these repulsions are frequently, if not generally, hereditary. Although, therefore, the sense of touch concerns physiology rather than pathology, there can be no question that in the one as in the other, heredity governs all the phenomena.

The senses of taste and smell are so allied as to be almost inseparable. Like the sense of touch, these latter ones concern also physiology rather than pathology, but where the phenomena are permanently involved in pathological conditions, then heredity is the rule, as in those which are purely physiological. The specific, as well as the individual varieties of taste and smell, are alike transmissible. I have elsewhere referred to the physiological phenomena, which are undoubtedly hereditary; but, for obvious reasons, beyond the fact that every form and variety of the sensorial development of smell and taste, whether congenital absence, anaesthesia or hyperaesthesia, in every degree, are subject to heredity, I cannot go. Purely pathological conditions of the senses of smell and taste are so generally, merely of a temporary character, that they cannot be regarded as transmissible, but in everything appertaining to the development and degree of the senses themselves, heredity is distinctly apparent, as indeed it would inevitably be pathologically, if their functions required the exercise of special local organs, as in the case of sight and hearing; or if, in like manner, they were subject to characteristic and definite diseases.

From the foregoing observations it will be seen that in relation to the sensorial qualities, heredity plays its part, and exercises its influence, not only physiologically but pathologically also. With regard to sight and hearing, we have seen that not only the visual and acoustic abnormalities and diseases are transmissible, but that, in the case of touch,

smell, and taste, every degree of development, whether anæsthetic or hyperæsthetic, is alike transmissible, and that wherever these latter abnormalities become developed to a morbid degree, here also heredity is the rule. In a word the sensorial organs, their functions and their diseases, are alike subject to the law of heredity.

*Diseases of the Skin.*—Anatomically and physiologically there can be no question as to the heritability of certain peculiarities of skin, some of which are, more or less, predisposed to certain morbid dermatological conditions. Some of the recorded cases of physiological and anatomical abnormalities of the skin are very interesting, and all the more so from the fact of their having been transmitted through many generations. The well-known case of the Lambert family is peculiarly interesting, as affording indisputable evidence of the transmissibility of an abnormal condition of the skin, which descended through at least five generations. The peculiar affection from which the family suffered consisted in their skin being covered with indurated, horn-like excrescences, affecting the entire body, except the head, soles of the feet, and palms of the hands. Edward Lambert, one of the earliest, if not the first member of the family so affected, had six children, only one of whom ultimately survived; but each of them had manifested the same peculiarity when six weeks old. The surviving son married, and all his male offspring were similarly affected, this extraordinary cutaneous condition having descended through at least five generations. Corns, and the indurated brawny cuticle of the feet in those who walk bare-footed, present a somewhat analogous condition of skin.

Another striking instance of the transmissibility of abnormal physiological phenomena is presented by the case

of Andrian Jeftichjew and his son Fedor, who were exhibited on the Continent and in England a few years ago, and whom I had an opportunity of examining during their stay in London. In Paris they were called *les hommes chiens*, and in London, the dog-men, Andrian's face being so covered with hair as to present a striking resemblance to the face of a Skye terrier. His excessive capillary development is not true hair, but simply an abnormal growth of the *down* or fine hairs which usually cover nearly the entire surface of the human body. Strictly speaking he has neither head-hair, beard, moustache, eye-brows, nor eye-lashes, their place being taken by this singular growth of long silky down. In colour this is of a dirty yellow: it is about three inches in length, all over the face, and feels like the hair of a Newfoundland dog. The very eye-lids are covered with this long hair, while flowing locks come out of his nostrils and ears. On his body are isolated patches, strewed, but not thickly, with hairs one and a half to two inches long. The son, Fedor, who was exhibited in company with Andrian, was illegitimate, and about three years of age. Andrian's legitimate children, a son and a daughter, both died young; nothing is known of the former, but the daughter resembled the father. The growth of down on Fedor's face is not so heavy as to conceal his features, but there is no doubt that when the child comes to maturity, he will be at least as hirsute as his parent. The hairs are as white and as soft as the fur of the Angora cat, and are longer at the outer angles of the eyes. There is a thick tuft between the eyes, and the nose is well covered. The moustache joins the whiskers on each side, after the English fashion, and this circumstance gives to accurate pictures of the child a ludicrous resemblance to a well-fed Englishman about fifty!

As in the father's case, the inside of Fedor's nostrils and ears has a thick crop of hair. Both father and son are almost toothless, Andrian having only five teeth, one in the upper jaw, and four in the lower, while the child has only four teeth, all in the lower jaw. In both cases the four lower teeth are all incisors. To the right of Andrian's one upper tooth there still remains the mark of another, which has disappeared. That beyond these six teeth the man never had any others, is evident to anyone who feels the gums with the fingers. The deficiency of teeth, accompanied as it is by what is in reality a deficiency, not a redundancy of hair, accords well with Darwin's view that a constant correlation exists between hair and teeth. He mentions as an illustration the deficiency of teeth in hairless dogs. The tusks of the boar, again, are greatly reduced under domestication, and the reduction is accompanied by a corresponding diminution of the bristles. He mentions also the case of Julia Pastrana, a Spanish dancer or opera singer, who had a thick masculine beard and a hairy forehead, while her teeth were so redundant that her mouth projected, and her face had a gorilla-like appearance. It should rather be said that in general those creatures which present an abnormal development in the covering of their skin, whether in the way of redundancy or deficiency, present generally, perhaps always, an abnormal dental development, as we see in sloths and armadilloes on the one hand, which have the front teeth deficient, and in some branches of the whale family, on the other, in which the teeth are redundant, either in number or in size.

To the foregoing cases many more might be added showing the undoubted heritability of cutaneous physiological abnormalities; but I would now go further, and assert that the

differentiation of individuals from one another, in consequence of heredity and variability, includes differences in the structure, functions, quality, and complexion of the skin, which are not only more or less hereditary, but which, however normal they may appear, will more or less predispose the skin to disease. These family and individual normal differences in the structure, functions, quality, and complexion of the skin are everywhere known and recognised, so that I need not here allude to them in any detail further than to state that, *cæteris paribus*, many of them predispose their possessors to certain morbid dermatological conditions.

It is well to remember at the outset that "there is nothing essentially special in the details of cutaneous pathological changes as compared with those which may occur in other parts."<sup>1</sup> In other words, between the facts of general and skin pathology there has recently been demonstrated such a general similarity that the same appearance, changes, and causes in morbid action are recognised in the diseases of the integument, as in the pathological conditions of other parts of the body. It is also necessary that the part played by various concomitant conditions in each individual should be estimated and appreciated, as these undoubtedly modify the character and derivation of the particular disease that may be present.

Without attempting to give any detailed classification of skin diseases—infinite in their variety of forms, as multitudinous in the names given to them—I may be permitted to roughly formulate them in the following ten groups, as given by Dr. Tilbury Fox—viz., the eruptions of the acute specific diseases; local inflammations; diathetic diseases; hyper- and atrophic disease; new formations; hæmorrhagic,

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<sup>1</sup> Dr. Tilbury Fox.

neurotic, and pigmentary diseases ; and disorders of the hair and glands and their appendages. With the exception of the first—viz., the eruptions of the acute specific diseases—which I have already discussed—and, perhaps, some of the parasitic diseases of the hair, there is not one of these forms which does not come, more or less, under the influence of heredity. With regard to these two exceptions, heredity, as I have elsewhere stated, shows its potency, as in the whole range of organic life, for it develops, sustains, and perpetuates the specific characters of the germs in the one, as it develops, sustains, and perpetuates the specific characters of the parasites in the other. How else could they be handed down unaltered in their specific characters, from generation to generation, except in accordance with the all-pervading universal law, roughly estimated by Lamarck—viz., “Like begets like”; and “Each after his kind,” as the Mosaic record has it? As I have said repeatedly before, there is no escaping the law of heredity, for it is as necessary for our development and perpetuation as the act of generation, or the air we breathe !

The causes of skin diseases may be thus stated :

- (a) Internal, or those which act from within the system upon the skin.
- (b) An innate disposition in the skin tissues themselves to take on a diseased action.
- (c) External, or those which act from without the system upon the skin. (Fox.)

I am here only concerned with the two former, in which many of the causes are hereditary ; but as similar diseases may arise from a combination of both of these causes, it may be expedient to consider them together, or rather to consider these morbid conditions of the skin in the causation

of which both these sets of factors are implicated. It may, indeed, be said that the majority of skin diseases are dependent upon both for their causation, as we may see in cases of erythema in a rheumatic subject, in connection with dyspepsia ; eczema in a gouty subject, dependent upon mal-assimilation ; psoriasis in a scrofulous subject, dependent upon alteration of the normal healthy character of the blood ; pruritis in connection with gout, hepatic derangement, or diabetes. Here, for example, in cases of erythema in a rheumatic subject, in connection with dyspepsia, the dyspepsia is an internal cause, dependent more or less upon the rheumatic diathesis ; mal-assimilation an internal cause, dependent upon the gouty diathesis ; alteration of the normal condition of the blood dependent upon the scrofulous diathesis, and so on ; the first producing erythema, the second eczema, and the third psoriasis : and in this connection it may be well to emphasise the axiom that the true cause of the state of any given disease is made up of a number of phenomena or agencies in combined operation. Excluding such non-hereditary agents as the acute specific poisons, medicinal substances, deleterious articles of food, etc., which may produce skin disease, we still have amongst the *internal causes* those more or less depending upon heredity, including gout, rheumatism, syphilis, leprosy, certain conditions in which injurious substances enter the current of blood, or are retained in it in undue proportions, as dyspepsia, mal-assimilation, functional uterine disturbance, and various morbid conditions of the liver, kidneys, and intestines ; also certain conditions of the nervous system, producing hyperæmia and urticaria, herpes, pemphigus, anaesthetic leprosy, and that impaired functional power involving loss of control over the skin nutrition, allowing morbid action of all kinds to take place more readily.

Concerning the innate disposition in the skin tissues themselves to take on a diseased condition, it is pretty certain, as Dr. Tilbury Fox observes, that many diseases of the skin must originate in a disordered behaviour of the tissues themselves, and do not necessarily depend for their cause upon any general defect of nutrition. For instance, cancer is a case in point ; and so also warty growths of all kinds, fibroma, keloid, and perhaps lupus, are other illustrations of the same thing. In some cases there is just an excess of growth, a *plus* state of the nutrition of the tissue, and nothing more (hypertrophic) ; or it may be a *minus* condition (atrophic). In other instances it is a perverted nutrition, a deviation in the type of the tissue, as in cutaneous cancer. The epithelial layers may be mainly affected, as in warts, corns, xeroderma, and ichthyosis, or the connective tissues of the skin may be specially involved, as in keloid, fibroma, morphœa, and scleroderma. Moreover, all the diseases of the sweat glands and follicles—of the sebaceous glands—of the hair and hair follicles, and of many of those of the nails, belong to the same category, and are all subject to the influence of heredity.

As showing how predisposition and insusceptibility—both of which I have elsewhere proved to be more or less the result of heredity—may influence parasitic diseases of the skin, I may here quote from Dr. Alder Smith, who says :—“ All children are not equally susceptible to ringworm. A certain *unknown condition* of the skin is necessary for the growth of the fungus. Some children never take ringworm, though certainly liable to become infected . . . On some the fungus takes but slight hold, and is easily destroyed ; others again appear to be extremely susceptible . . . The difference in these cases must depend on some peculiar

nutritive condition of the soil or material in which the fungus develops, or upon some special state of the general health or constitution. In fact, the *state of the soil* is a most important condition, and the rapidity with which a small spot of ringworm will *spread* before it comes under efficient treatment, depends chiefly upon the peculiar and unknown condition of the soil or *nidus*." In seeking to account for this "unknown condition," whether of the nature of pre-disposition or insusceptibility, I maintain that it depends upon idiosyncratic peculiarity in the structure of the infected parts, which, like all other idiosyncratic conditions, has been transmitted hereditarily. Having already discussed the idiosyncrasies of structure represented by certain inherited proclivities of tissue, I need not refer to them here in any detail further than to state that they account for those pre-dispositions and insusceptibilities referred to above by Dr. Alder Smith, and are very frequently the primary causes of such skin diseases as ichthyosis, psoriasis, xanthelasma, molluscum fibrosum, etc., and probably also of "steatomata of the scalp, lipomata, adenomatous tumours in the breast, multiple uterine fibroids, milium, whether on the face or elsewhere, and a host of others."<sup>1</sup>

As illustrating further, and more forcibly, the inherited proclivities of the integument I may here refer to the various forms of acne, which undoubtedly denote original and heritable peculiarity in the structure of the skin. As Mr. Hutchinson says:—"The location of acne on the face is probably often explained by pre-existing peculiarities in the state of the skin of the face . . . Acne is very constantly hereditary, the same form often prevailing in several members of a family, and acne tuberosa, I believe, often descends

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<sup>1</sup> Hutchinson.

in several generations from father to son." The differences in the various forms of acne are accounted for primarily by differences in the skin of the affected individuals, and these differences may be said to consist in relative thickness of the skin, and a hyper-development of the sebaceous system, which are unquestionably subject to heredity.

Eczema is another affection dependent more or less upon a constitutional proclivity, which is also hereditary. Usually associated with gout, scrofula, or neurasthenia, eczema may result from either of these conditions, all of which are hereditary, and it may be safely asserted that those individuals who have inherited the gouty, scrofulous, or neuropathic diathesis are especially predisposed to eczematous affections. Eczema must be regarded as practically the most important of cutaneous diseases, if only on account of its comparative frequency, including as it does more than one-third of all cases of those diseases which come under treatment. It is also remarkably protean in its manifestations, showing itself under the most varied forms. The predisposition to eczema differs to a remarkable extent in different individuals. As with some persons every trifling irritation of the stomach gives rise to gastric catarrh, so in others a mere chafing of the skin will cause an attack of eczema. Amongst the predisposing conditions to this affection may be mentioned chlorosis, rachitis, scrofulosis, gout, albuminuria, diabetes, dyspepsia, gastric and intestinal catarrhs, dysmenorrhœa, uterine affections, lactation, and pregnancy. Psychical influences may also be the immediate cause of the complaint where a predisposition exists. Persons having a very delicate skin are more liable to eczema, and susceptibility in this direction is also increased by repeated attacks. That eczema is in itself hereditary, beyond a mere predisposition.

to it, is also beyond doubt, as several authors have met with frequent instances of its occurrence by descent. That so few have recorded such cases is probably due to the fact that in private practice only the most inveterate cases come under notice, in which category hereditary eczema must undoubtedly be placed. For example, a girl of sixteen was placed under the care of Drs. Veiel (*pere et fils*) by her father, a medical man. He himself, and his mother, as also his second daughter, were sufferers from the complaint. Similar examples might be multiplied. Eczema is observed with special frequency in scrofulous and phthisical families.<sup>1</sup>

Psoriasis is another well-known skin affection in which heredity, if not its sole cause, plays a very prominent part, and illustrates many of its peculiarities, as atavism, etc. No rigid proof, says Weyl, can be brought at present that psoriasis develops *de novo*, or can be produced mechanically or chemically. Bazin regards it as a constitutional diathesis, mainly hereditary, which is either of arthritic or herpetic origin, and gives, as he imagines, the characteristic differences of both forms. Others assume principally a single, unknown, internal cause—the dartrous diathesis. Weyl, further, considers it probable that it is due to a functional weakness of the nervous centre regulating the nutrition of the skin, dependent on hereditary taint; this view is favoured by the constant monotonous form of the efflorescence, and its tendency to symmetrical development. The anatomical process is merely the peripheral projection of the functional central disturbance. According to Neumann, prurigo and ichthyosis have never been found associated with psoriasis, showing that all dermatoses may be combined, and that a number of them exclude one another.<sup>2</sup> There can be no

<sup>1</sup> Dr. Th. Veiel (Ziemssen).

<sup>2</sup> Dr. Weyl (Zeimssen).

doubt that psoriasis not uncommonly occurs in several members of a family, and that it may be transmitted for several generations. Dr. McCall Anderson's view as to the cause of this affection is that it is an inherited perverted tendency of tissue formation, which tendency lies dormant until called into activity by some exciting cause; and it is probably not due to a special blood condition, or dyscrasia, or diathesis, but is due to a peculiar morbid tendency of parts of the skin, which is obviously hereditary. In other words, it is neither primarily nor altogether due to any condition of the blood or nervous system, but its causation materially consists in an inherited proclivity of cutaneous tissue—an idiosyncrasy in the structure of the skin itself. Mr. Hutchinson explains the entire absence of psoriasis in infancy and early childhood by suggesting that when the structural idiosyncrasy is very strong, it may manifest itself in a different form. Thus, he thinks it not improbable that the ichthyosis of infants may be in this way the representative of the psoriasis tendency in its intensest form. Psoriasis is, therefore, markedly hereditary, persisting through many generations, and will sometimes be found to undergo apparent transmutation with other forms of skin disease, as nummular eczema, lichen ruber, and pemphigus.

Of all other skin diseases, none affords such direct proof of its hereditary character as ichthyosis, which generally occurs in several members of the same family, but frequently omits a generation, or fails to descend in the direct line. Hardy goes even so far as to assert that if other members of the family are not found affected with ichthyosis, this disease will certainly be found affecting some near friend of the patient's. There are many instances on record where the disease was transmitted from mother to son, and from father

to daughter, although usually transmitted to those of like sex. Its frequent occurrence in brothers and sisters, without any external influences being recognised, is further proof of the hereditary nature of ichthyosis.<sup>1</sup>

Of the other skin diseases—and their name is legion—I maintain that there is scarcely one of them—not one of them, in fact, of a constitutional character—which is not more or less subject to the law of heredity, either as an actual or predisposing cause. To discuss those forms which I have left unnoticed in any detail would occupy more space than I can at present command, and would, after all, be a work of supererogation, as the various forms already referred to are not only in themselves the most important among the dermatoses, but may be said to fairly represent the various classes of cutaneous affections. Whether, therefore, of the nature of local inflammation, diathetic diseases, hyper- or atrophic disease, new formations, hæmorrhagic, neurotic, or pigmentary diseases, or disorders of the hair, glands, and their appendages—heredity is a potent factor in their production, either by actual transmission, or a predisposition resulting from inherited morbid proclivity in the tissue of the skin itself.

I have already said that the details of cutaneous pathological changes manifest nothing essentially special, as compared with those occurring in other parts of the body; and thus, in the local inflammations of the skin—whether erythematous, catarrhal, plastic, or suppurative—we find the inflammatory process identical with that in other parts, and in this connection it should be remembered that the more frequently the tissues have yielded to any special process of

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<sup>1</sup> Dr. E. Lesser.

inflammation, the more prone they are to yield again ;<sup>1</sup> and thus, a diathetic condition may be established in an individual, who may transmit the same to his offspring. It is, at any rate, a well-known fact that while some individuals and families are especially predisposed to inflammatory processes, others are not, and it is amongst the former that local cutaneous inflammations generally occur. With regard to the cutaneous eruptions which are known to be local manifestations of diathetic states, and which include scrofuloderma, syphiloderma, leprous eruptions, framboësia or yaws, etc., it goes without saying that heredity is a potent underlying element in their production.

In those affections of the skin included under the names hypertrophic or atrophic there is essentially an innate disposition in the skin tissues themselves to take on a diseased condition, and the same may be said of the majority of the diseases of the sweat and sebaceous glands, of the hair, follicles, and nails. In the former category are included, amongst the hypertrophic variety, warts, corns, xeroderma, ichthyosis, keloid, fibroma, morphœa, and scleroderma : and amongst the atrophic, senile and linear atrophy, and general marasmus. As these are all more or less dependent upon an inherited predisposition in the integument itself, it is evident that here, too, heredity is of prime importance in their production.

Concerning new formations, I have elsewhere shown that they depend upon diathesis, constituting as they do one of the diathetic varieties. This group includes lupus, cancer, rodent ulcer, and xanthelasma. Mr. Hutchinson regards

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<sup>1</sup> For a detailed discussion of this interesting subject the reader is referred to Mr. Jonathan Hutchinson's most admirable and very suggestive work, "The Pedigree of Disease," to which the writer is under many obligations.

the former as "a sort of cross produced by tendencies at once to scrofula and cancer, and that it receives many modifications from peculiarities in the patient's skin, and his morbid tendencies in one or the other direction." Much the same may be said with regard to rodent ulcer, and as to cancer I must refer the reader to what has already been said as to the diathesis of malignant new growths. Xanthelasma is "in part a new growth, and in part a fatty degeneration," depending upon long hereditary descent, and may be regarded as the original offspring of the hepatic diathesis.

Of the hæmorrhagic division of skin diseases purpura is the only illustration, and it is said to be non-hereditary; if so, it must be regarded as the exception which proves the rule! Although it has been asserted that this condition depends upon a morbid alteration in the liquor sanguinis, and that it also involves an affection of the vaso-motor nervous system, as a matter-of-fact nothing definite is known as to its etiology. As to its being the result of a diseased condition of the vascular system, which has also been stated, although evidence of any anatomical alteration in its structure is wanting, "yet there are certain conditions in which a disease of that structure must be presupposed, which exist whenever slight causes give rise to hæmorrhages in parts far distant from each other, and which constitute what is known as the *hæmorrhagic diathesis*."<sup>1</sup> I have elsewhere shown that, according to Mr. Jonathan Hutchinson and others, this diathesis is the result of the long descent of gout; and why, may I ask, should not purpura be the result of the complicated agencies of heredity acting and reacting on human tissues, amid various morbid conditions for an indefinite period, until it is produced in certain

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<sup>1</sup> Professor Ernst Schwimmer.

individuals? If all our tissues, whether in health or disease, are subject to heredity, I do not see why this comparatively rare condition—whether dependent upon vascular or vaso-motor change, should not occasionally be evolved in the case of certain individuals, as the result of complicated tissue proclivities which have been inherited. Until, however, the exact pathological conditions which engender purpura are thoroughly established, I am content to allow this affection to remain amongst the category of those whose dependence upon heredity is "not proven." It should not, moreover, be forgotten that a purpuric condition is also associated with scurvy, and that this latter affection is included amongst the diet-diatheses by Mr. Jonathan Hutchinson.

Amongst the neurotic affections of the skin are included hyperæsthesia, anæsthesia, and pruritus. The two first are so evidently dependent upon neurasthenic or neuropathic conditions, which are admittedly hereditary, that they need only be mentioned; and the latter can only be included amongst those cases of idiosyncratic susceptibility in which the skin is inherently hypersensitive, as manifested by the different results produced upon different individuals by the bites of various insects, contact with woollen clothing, etc. Of those cutaneous affections depending primarily on deposit or alteration of pigment, and including melasma and leucoderma, nothing much can be said, as nothing definite is known as to their causation. They are, however, of little importance, and what I have said as to purpura will apply equally to them. It may, however, be remarked that certain individuals and families are more subject than others to the forms of pigmentation resulting from exposure to the sun, and that chloasma gravidarum characterises many families during the pregnant state.

Instead of considering the multitudinous forms or varieties of skin affections in detail, I have preferred, for obvious reasons, to deal with them for the most part synthetically, and have now referred to the various groups into which every case of skin disease must fall. I have subjected each group to an examination as to how far heredity can be regarded as an element in its production, and I think I have shown that, in at least the majority of them, hereditary transmission or predisposition is an etiological factor of essential importance.

My observations on the all-pervading law of heredity must now draw to a close. I can only hope that the results of my study may be as gratifying to my readers as the task has been to myself, and that at least some good may have been affected in consequence of my inquiry. I have, for I believe the first time, subjected the various diseases and disorders to which the human body is liable to an examination, as to how far they are the results of or referable to hereditary transmission, and in the words of Mr. Jonathan Hutchinson, to whose labours I owe so much, "It is abundantly sufficient for my ambition, if, availing myself thankfully so far as my knowledge extended, of the labours of those who have gone before me, I have succeeded in any degree in making opinion more definite, and giving emphasis to that which is true."

In conclusion, the following summary of the views enunciated in these papers may not be altogether unacceptable.

*Summary.*—Heredity, as we have seen, is one of the fundamental laws of living Nature, by which all organic beings tend to repeat themselves in their progeny, and it underlies the grand evolutionary processes by which, according to the Darwinian theory, all organic beings have

been produced. The effects of this great law have been recognised and appreciated from the earliest ages ; and, while the axiom of Lamarck that "like produces like" may be true as a generalization, yet the tendency to variation which is manifested in all animals as resulting in the differentiation of individuals—is so potent as to frustrate the attainment of the ideal law.

The office of Science consists in the interpretation of natural laws, by means of the study of phenomena in relation with experience. Heredity is a physiological necessity of our being inseparably connected with reproduction, and the mysterious source of both may be traced to the fusion of the sperm and germ cells, resulting in a germinal vesicle. Analysing the human organism somewhat in detail, it is found that the likeness between parents and children, although by no means absolute, characterises not only every element of their form, features, and expression, but also every action, every function of their physical being, extending even to the transmission of idiosyncrasies, habits, and acquired modifications, so that every anatomical conformation—every physiological function and process—the varieties, and the minutest peculiarities of the individual in structure, composition, and properties, are alike found to be subject to the grand law of heredity.

The correlation and interdependence of the laws of heredity and variability are well recognised in the great evolutional theory of Darwin ; and the so-called laws of heredity, under which all the main facts are usually grouped, may be thus briefly formulated :—

- (1) Direct Heredity.
- (2) Reversional Heredity or Atavism.
- (3) Collateral or Indirect Heredity.
- (4) The Heredity of Influence.
- (5) Specialised or Initial Heredity.

Between physiology and psychology there exists not only an intimate correlation but an exact parallelism. The Brain is the organ of the Mind, and thought but the result of brain action ; and as the brain, as regards its size, structure, and qualities is hereditarily transmissible, we are warranted in asserting that every mental or intellectual state is conditioned by a pre-existing physiological state and that psychological heredity has its source in physiological heredity. Like all other groups of natural laws, physiology and psychology are simply terms used to denote the groupings of certain phenomena which experience has enabled us to perceive are reducible to law. The physiological phenomena concern unconsciousness, but inasmuch as every mental condition implies and necessitates an antecedent physical condition, there is of necessity an intimate correlation between both. Thus the functions of the spinal cord, the medulla oblongata, the cerebellum, are performed unconsciously, and even the brain itself is capable of unconscious cerebration.

Proceeding from the unconscious towards the conscious, we find that instincts, owing to the fact that the psychical as well as the physical nature are unquestionably transmitted from parents to their children, are hereditarily transmissible ; so also are the modes of sensorial activity denominated the perceptive faculties ; as every deficiency, and extraordinary development of any of the senses are indubitably passed on from parents to their offspring. To these latter must, moreover, be added memory and imagination, which are likewise potentially transmissible by heredity. Are the higher, like the lower modes of intellect, transmissible ? As the unity of the intellect is recognised and admitted by all schools of thought, and as facts undoubtedly prove the

heredity of the lower intellectual modes, it must follow as a natural sequence that all the higher forms of the human intellect are also subject to this law. If we regard intellect and reason from a transcendental point of view, they transcend experience, and are thus beyond the sphere of science; but if we consider them phenomenally, there is no reason why they should be exempted from the law of heredity, and thus considered, they are without doubt inherited.

In like manner the sentiments and passions are also transmissible; and if we avoid all polemical discussion as to free-will and heredity, the human will, regarded phenomenally—that is with regard to the immense resolution, boldness, courage, self-confidence, and mastery over the timid and irresolute which characterise the possessors of strong wills—is also unquestionably hereditary; so too the evolution and fixation of national characteristics are primarily the result of heredity. From this rapid and imperfect summary it will be seen that all that we *have* and *are* as individuals constituted for the performance of certain functions, we owe to heredity, with the exception of the developing influences of our “environment” through life, and the educational processes to which we have been subjected.

Having thus far proved the inheritance of man’s physiological and psychological nature in detail, I discussed the individuality of man as developed by the interaction of heredity and variability, and showed that however perfect the likeness transmitted from parents to their offspring, it is never either organically or dynamically exact; and however closely the *partus* may resemble the *parens*, physically, mentally, or morally—however closely the former may resemble the latter with regard to temperament, idiosyncrasy,

diathesis, and hereditary predisposition—yet each child preserves its own individuality by reason of the differentiation produced by natural variability, to which every organic being is subjected, in addition to heredity. Remembering that each one of us has inherited certain peculiarities—physiological, psychological and pathological—which we, in turn, shall pass on to our descendants, I thus sought to prove the reason why every individual differs in these respects from every other, and why those peculiarities which distinguish us from one another in health should also tend to modify or intensify our relative proneness to certain morbid affections, by the neutralisation or development of the morbid susceptibilities or predispositions which have been transmitted to us.

Defining *diseases*, in the abstract, as not entities, but mere groups of modifications of structures already in existence, and of actions always progressing in a vital system—in fact particular conditions of the living body, new phases of its vital manifestations, whether of the nature of functional derangement or organic or textural degeneracy—I was led to conclude that the differentiation of individuals concerns not only their physical nature and functions, their mental qualities and moral character, but also their morbid processes, whether functional or organic. In other words, as the physiological and psychological nature of every individual—*inherited and acquired*—differs from that of every other, so too must every individual differ from every other as to his pathological predispositions. Thus, whether we consider man physiologically, psychologically, or pathologically, we find the potency of heredity in his every aspect, and so far as this influence extends there is an exact parallelism between physiology, psychology, and pathology; they are, in fact, names denoting man's organism and dynamism in

health and disease, both of which I contend, in diseases as in health, are essentially subject to the law of heredity.

In considering what is meant by predisposition, I discussed it under the following heads—viz., hereditary, ætal, sexual, and acquired, and showed that it consisted in a peculiar state of the physical and mental constitution of every individual, mainly hereditary, which renders him specially liable to suffer injuriously from the effects of certain morbific agents, and when these latter are of a non-specific type, predisposition will determine the particular disease which it shall induce in each of several individuals similarly exposed to it: whilst in the case of a specific agent or morbid poison, it determines the relative liability of several individuals similarly exposed to it, to become the subject of the particular diseases it is capable of originating, and also influences the severity of its attack.<sup>1</sup> In other words, just as every individual differs from every other physiologically and psychologically, so he differs from every other in his predisposition to disease, and all these differences are the result of heredity and variability. Predisposition is, in fact, a tendency, mainly hereditary, in the tissues or organs of the body to readily assume certain morbid processes, in the presence of certain exciting causes, and may thus be regarded as the result of a minor degree of heredity to that in which certain morbid conditions are actually transmitted. There is probably no individual in existence who has not inherited some predispositions to disease, and we thus see that heredity and variability influence man physiologically, pyschologically, and pathologically, in fact, as in health, so also in disease. Instead of a predisposition, it may be an insusceptibility to certain

<sup>1</sup> Dr. W. B. Carpenter.

diseases which is inherited, but this latter can only be regarded as an effect of the same causes working differently, as they do in every individual—producing in one a predisposition, in another an insusceptibility. Regarding, then, hereditary predisposition to disease as a scientific fact, and bearing in mind that none of us are free from its influence —since it is also scientifically correct to say that every atom and function of man's physical and mental nature are also subject to heredity—it assuredly must follow that the same atoms and functions are liable to certain morbid processes in consequence of the same influence, especially as diseases are merely particular conditions of the living body, new phases of its vital manifestations, whether of the nature of functional derangements, or of organic or textural degeneracy. To sum up: man, physiologically and psychologically, to the minutest detail, being subject to the law of heredity, it must follow that he has also inherited certain predispositions to disease which, in the presence of certain exciting causes, will develop into active morbid processes: in a word, man is alike subject to heredity in health and in disease.

In addition to hereditary predisposition, we find that the individuality of man consists also of temperament, idiosyncrasy, and diathesis. How do these latter affect the predispositions to disease in individuals? The temperaments are the sanguine, nervous, lymphatic, and bilious. The sanguine predisposes to diseases characterised by the rapidity of the inflammatory process, and predisposes its possessors to acute affections, which develop themselves regularly and completely, defervesce rapidly, and generally with well-marked symptoms of crisis. The nervous temperament predisposes to disorders of the nervous system, convulsive diseases, various congestions and haemorrhages, hepatic and

internal obstructions, neuralgia, insanity, and melancholia. The diseases to which the lymphatic temperament predisposes are generally of a chronic character, and of an asthenic type, as debility, tuberculosis, scrofula, and dropsy; and the bilious temperament tends to dyspeptic affections, hypochondriasis, and hepatic derangements generally. The temperaments are types of inherited physical and mental constitution, and are generally "mixed" in different individuals, while one may predominate. That they predispose to disease we have just seen. Idiosyncrasies, always inherited, also predispose to disease, or may produce insusceptibility. There can be no doubt that they depend upon peculiarities of physical structure. They predispose to certain morbid processes, as, for example, the specific or exanthematous fevers. It may be an extraordinary immunity that they reveal, or an incredible degree of susceptibility, and they account for the various degrees in which different individuals are affected by scarlet fever, small-pox, typhus and typhoid fever, diphtheria, erysipelas, syphilis, carbuncle, etc. "There are few of us without our idiosyncrasies, and their variety is innumerable."<sup>1</sup>

The diatheses are of still greater importance, consisting as they do of morbid proclivities existing in an individual or family, in consequence of his or their heredity and environment; or, still better, "of any condition of prolonged peculiarity of health giving proclivity to definite forms of disease."<sup>2</sup> I adopted the classification of Mr. Jonathan Hutchinson because it is founded on a scientific basis, and is in accord with the natural history of disease, and considered in detail the following varieties:—The three universal diatheses, viz. : the scrofulous or tubercular, the rheumatic,

<sup>1</sup> Mr. Jonathan Hutchinson.

<sup>2</sup> Ibid

and the catarrhal. The two climatic, viz. : the malarial, and the bronchocele. The four dietetic, viz. : the gouty and haemorrhagic, the leprous, the scorbutic, and the rachitic ; and, after these the diathesis of malignant new growths, the diathesis of senile degeneration, the visceral diathesis, etc. It would be very easy to add to these in every direction, but those referred to suffice to show that my object has been to include diathetic diseases in such groups as bear upon their long descent by heredity, and not the elaboration of a mere detailed classification, which I could have readily supplied by exercising a little ingenuity. Without recapitulating the details of the various diatheses considered, I shall now content myself by repeating that, as the so-called Laws of Nature represent merely the grouping of certain phenomena, so diathesis may be regarded as the grouping of certain constitutional peculiarities, having certain pathological tendencies, in certain families or individuals ; and as every individual differs from every other, in every respect, we must naturally be prepared to admit a similar differentiation with regard to his diathetic peculiarities. Diatheses are, in fact, but rough types of constitutional peculiarities, showing a predisposition to certain diseases, which may be variously blended in different individuals, while the original type is more or less preserved.

It should, however, be remembered that the temperaments, idiosyncrasies, and diatheses, however influential as factors in modifying morbid processes in individuals, receive their force and character from heredity, and may thus be said to be merely effects of hereditary predisposition specialised in certain sets of individuals ; but hereditary predisposition means far more than the temperaments, idiosyncrasies, and diatheses, for it not only includes all these, but also implies

that a morbid predisposition which has arisen in some individual, whether ancestral or parental, has, by heredity, been transmitted to his offspring, and either intensified by descent, or modified by age, sex, or accessory circumstances. In speaking of diseases as hereditary, I do not mean that the diseases themselves, occurring either in ancestors or parents, are actually transmitted to their offspring (who, under those circumstances, would be born with them), but what is really meant is that a certain organic constitution is inherited by the children, which being likely to undergo pathological development in the ordinary circumstances of life, is therefore described as a constitutional predisposition or tendency to disease.

If it is admitted, as I have indicated, that every individual is subject to heredity in his physical, mental, and moral constitution, and to such an extent in his physical organisation that the minutest structure of his every organ and tissue is characterised by it—it seems to me but a natural sequence that the life-history of his parents' organs and tissues will be re-enacted to some extent, at least, in his own, and that when they have developed organic or tissue derangement or degeneracy of any kind, he, too, will at least have inherited a predisposition to the same. This, I think, may be accepted as a broad statement of a general truth—the truthfulness of which is not assailed even when we consider the effect of such modifying factors as individual varieties of age, sex, and circumstances.

With the object of inquiring how far this view is supported by the records of experience, and of actual disease, I passed in careful review the majority of the diseases "which flesh is heir to," including intra-uterine diseases, diseases of the circulatory and nervous systems, of the respiratory organs,

the kidneys, the chylo-poietic system, the liver, chronic and acute infectious diseases, diseases of nutrition, and of the locomotive organs, of the special senses, and of the skin, and the result is now before the reader. If my examination has served no other good, it has, at least, established in my own mind the accuracy of the views herein enunciated, and I can only hope that the mass of facts which I have brought to bear on the affirmative side of the question may, at least, serve as an inducement to other observers to take a livelier interest in the subject. As far as the groups of diseases which I have considered are concerned, it seems to me that the facts recorded prove beyond a doubt that children inherit from their parents not only their physiological and psychological nature—modified in every case to some extent by variability—but also a predisposition to the constitutional diseases or disorders from which they have suffered, and that, in disease or in health, heredity is a factor of prime importance.

So far as I am aware a systematic attempt has never before been made to trace the influence of heredity as an important factor in the origin and development of the diseases which afflict humanity, and if the facts which I have adduced tend to prove that heredity influences them all, and that *because* we owe our organic nature—all that we *have* and *are*, with the exception of the influences of our environment—to this universal law, *therefore* our morbid predispositions spring from the same source, I shall be well satisfied. I have sought to establish a parallelism between physiology, psychology, and pathology as representing man in health and disease, and I think I have succeeded in showing that heredity governs these three aspects of his organic nature and its condition. Be that as it may, heredity

is a fundamental and universal law of living Nature, and there can at least be no doubt that the entire physiological and psychological nature of parents is transmitted, with some modifications, to their children; this being so, it assuredly follows that disorders or diseases, which are nothing more than modifications of structures already in existence, and of actions already progressing in a vital system, are likewise transmitted, and usually in the form of a predisposition with which the tissues of the children are mysteriously branded. In a word, if the physiological and psychological nature of man is inherited and transmissible, so must everything that concerns his pathology, except that which he owes to the influence of external circumstances during his "struggle for life."

Before concluding I must allude, however briefly, to another and equally important aspect of heredity—viz., that concerning the transmissibility of man's *moral nature*—and I approach this subject with considerable diffidence, feeling that I am about to tread on very delicate ground. At the very outset of every study of morals we are met by the mysterious and inextricable problem of free-will. I wish it to be distinctly understood, however, that my remarks are made in a purely scientific spirit, and entirely apart from theological dogma or doctrine of any kind. As I have elsewhere stated, if phenomena be reducible to a law, their investigation constitutes a science. Science can only deal with phenomena and experience; and when we come to regard the ultimate causes of any of these groups of natural phenomena, and find them not reducible to law, they transcend experience, and Science pauses paralysed at the very threshold of such an inquiry. But just as science can concern herself with the phenomena which are purely physical

or mental, so it is in her province to observe and interpret phenomena which belong to what is called the moral nature of man, in the light of experience ; and so far as the purposes of this work are concerned, we may rest assured that as in the physical and mental nature of man heredity exercises a most potent influence, so it does with regard to that part of his individuality which is denominated moral. In a word, heredity dominates the whole individuality of man. In every purely scientific estimate of this individuality the moral aspect must be regarded from the same standpoint as the physical or mental, and it is here that Science and Theology have waged their fiercest battles. Ribot, in discussing the irreconcilability of heredity and free-will, says : “ Clearly there can be but two hypotheses—either we must say that at every birth there is an act of special creation, which places in each being the germ of its character, of its personality ; or we must admit that this germ is the product of preceding generations, and that it necessarily comes from the nature of the parents and from the circumstances of the generative act.” Here I leave this question, having no wish or intention of discussing it, but I contend that as there is a parallelism between the physiological and psychological nature of man, so there is, and must be, between his psychological and moral nature, and that they are all equally hereditary.

The moral nature of man has been developed, as his mental nature has been, by heredity acting through countless æons of time *pari passu*, and coterminously with the progress of civilisation. In his primitive state of barbarism and savagery man had no adequate idea of morality. To hunting succeeded pastoral pursuits, and to pastoral, agricultural, and it is only with the latter that we can associate

the dawn of civilisation. " Primitive man, ignorant and idealess, the slave of his appetites and instincts, which were simply the forces of nature freely acting in him, rose but very gradually to the conception of the ideal. Art, poetry, science, morality, all those highest manifestations of the human soul, are like some frail and precious plant which has come late into being, and been enriched by the long toil of generations."<sup>1</sup> Carlyle has said that civilisation is only a covering underneath which the savage nature of man continually burns with an infernal fire ; and that the philosopher was right is easily proved by the facility with which, on provocation, even the most civilised and highly educated manifest a reversion to the primitive instincts of the race, which in a moment may burst all the bonds which civilisation has imposed upon them—when the brute nature appears with all its unbridled appetites and savage passions, and reasserts itself in its primitive barbarism. For, as Ribot has well said, there exist in the bottom of the soul, buried in the depths of our being, savage instincts, nomadic tastes, unconquered and sanguinary appetites, which slumber but die not. They resemble those rudimentary organs which have outlived their functions, but which still remain as witnesses to the slow, progressive evolution of the forms of life. And these savage instincts, developed in man during the past, whilst he lived free amid the forests and streams, are from time to time recalled by heredity, as though to let us measure with the eye the length of road over which we have travelled. The basis of morals is responsibility ; but heredity influences alike tendencies which are resistible and those which are irresistible, and here we are once again met with the unceasing conflict between free-will and fate, and I will only add that in this warfare, fatalism is more often

triumphant than is usually admitted or imagined. Even Burdach, a staunch supporter of the free-will theory, admits that "heredity has actually more power over our mental constitution and our character than all external influences, physical or moral." To quote Ribot once more: "If it be admitted," he says, "that the moral act comprises a great number of ideas, judgments, and sentiments (as has been already shown by the influence of heredity on the development of sensibility and intelligence), then heredity also exerts a great influence on the formation of habits and of moral ideas—*moral heredity is only a form of psychical heredity.*"

To escape, however, from theory to phenomena and experience which we can deal with in a spirit of scientific inquiry, properly so-called, and apart from metaphysical disputations which are too frequently hypothetical, the reader is referred to the earlier portion of this work, where, in considering the heredity of the sentiments and passions, I have alluded to tendencies to vice and crime as a heritage which descends with the certainty of fate. There is, in fact, no form of vice or of crime which may not be perpetuated by heredity, and, if space permitted, it would be an easy task to cite manifold and indisputable cases to prove this assertion. I therefore maintain that like the physical and mental nature of man, his moral nature also is transmitted hereditarily. I have no desire to separate the resistible from the irresistible tendencies which are thus transmitted, as this would involve theological arguments which I have neither the intention nor the capacity to discuss; but bearing in mind the influence of circumstances, in addition to that of heredity, in the development of character, I may be permitted to ask if our legislature and our codes of morality have adequately considered these

combined influences in their efforts to mitigate the evils of crime and vice. I trow not. It must be admitted that there are many individuals to whom Nature and Life seem to have been so cruel, that they appear to have little or no chance in the struggle for existence. We have already seen that *cause* and *effect* underlie all moral, as they do all physical and mental phenomena ; and when we peruse the life histories of such as these, we cannot but be impressed by the fact that Nature, by her inexorable law of heredity, has so handicapped them in the race, and Life has surrounded them with such baleful circumstances that success seems all but hopeless and impossible. One of these poor souls now and again

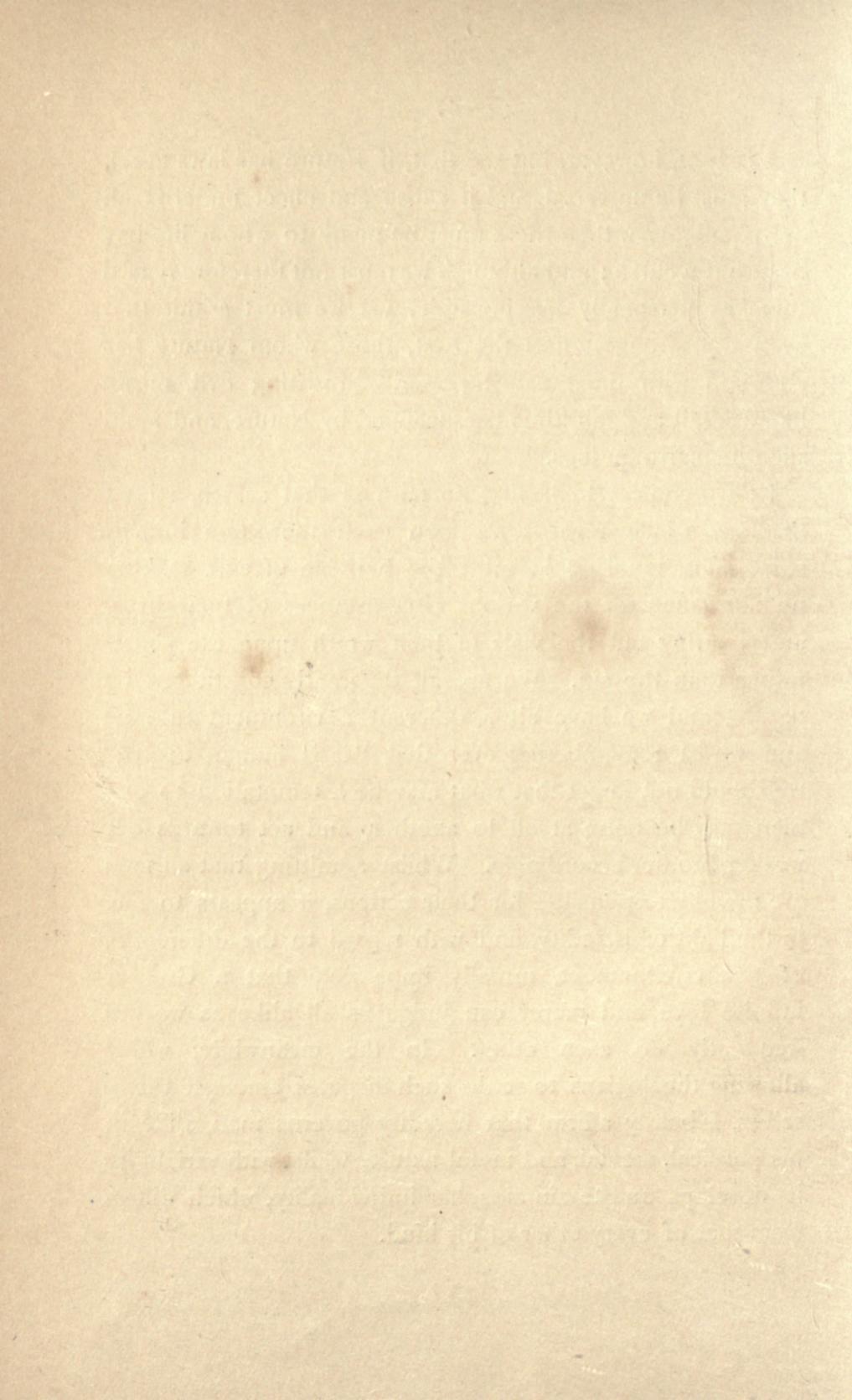
“ Breaks his birth’s invidious bar,  
And grasps the skirts of happy chance,  
And breasts the blows of circumstance,  
And grapples with his evil star.”

But alas ! how many go down through suffering and crime to disease and death, God alone knowing how hard it was for them to do anything else. Schiller says “ this is the peculiar curse of evil, that it must continually reproduce evil ; ” whilst we therefore glibly prate of “ moral responsibility,” let us trust that the All-Father may in His infinite goodness and mercy, judge us with both, and not as we judge one another. Calderon, in his tragedy “ Life a Dream,” puts into the mouth of King Basilius, speaking of Sigismund, the following words :—

“ Though his inward disposition  
Has destined him to destruction,  
Still he can avoid it ;  
Since the most obstinate fate,  
The most ungovernable desires,  
The most unfavourable stars,  
Are able only to direct the will,  
But conquer the will they cannot.

I cannot, however, but see that, if Nature has laws at all, they must be universal, and if cause and effect underlie all her phenomena, then there must be many to whom life has been but a curse ; and although we must not therefore regard them as personally irresponsible, yet we must admit that even the strongest and the best, those whom Nature has endowed with the greatest power of resisting evil, might likewise fall and fail, thus handicapped by Nature, and amid such life surroundings.

I must confess to having no faith in that selfish, stilted theology which regards all men from the same human standpoint, ignoring in most the heritage of evil, making no allowance for the various circumstances of their lives, and pouring out the vials of their wrath upon the sinner rather than the sin. We are all differently constituted by nature, and we have all a different environment in life ; and whilst remembering ever that "it is human to err," we should not forget that what may be a temptation to one man may be none at all to another, and act towards our weaker brother accordingly. Whilst admitting that all men are morally responsible for their actions, it appears to me, in the light of heredity, and with regard to the differences of our environment, morally impossible that a God of infinite love and mercy can judge us all alike as we too frequently do each other. In the meanwhile, whilst allowing theologians to settle such disputes amongst themselves, I boldly affirm that heredity governs man alike in his physical, mental, and moral nature, whilst with variability it develops and maintains his individuality, which differs from that of every other of his kind.



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